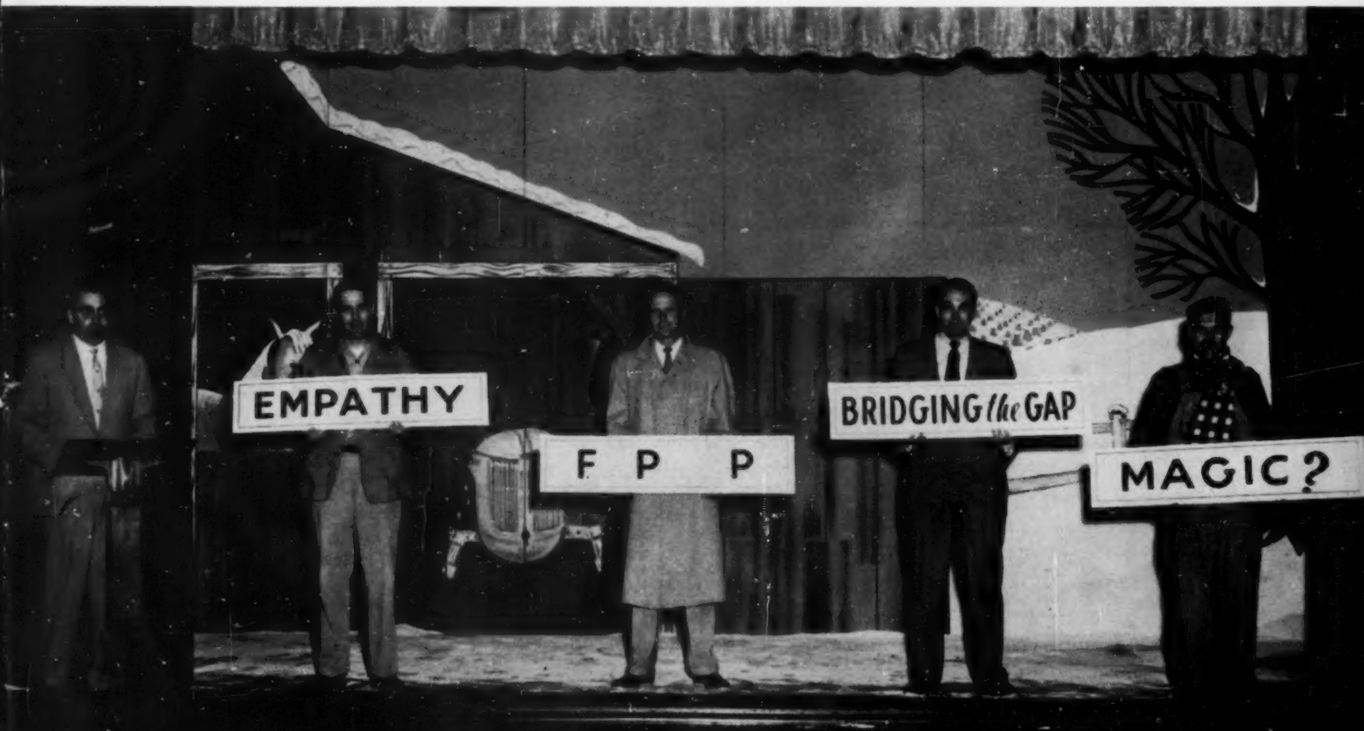
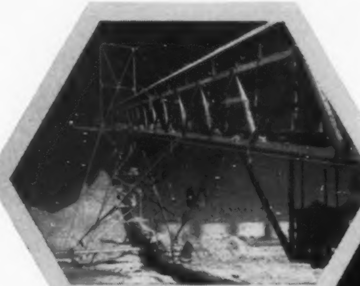
may 1958

nlgi spokesman

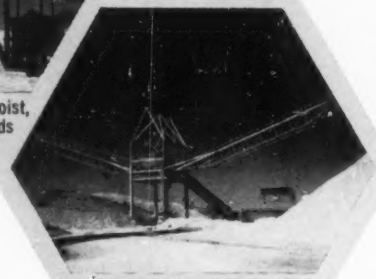
journal of the national lubricating grease institute



"In 14 months...not a single bearing lubrication failure with lithium-base grease!"



Conveyor-stacker handling moist, sticky material which builds up on the rollers.



Ore unloading conveyor rollers handling 200 tons of ore per hour.

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Pinion gear transmitting power from 600 h.p. motor to a ball mill.

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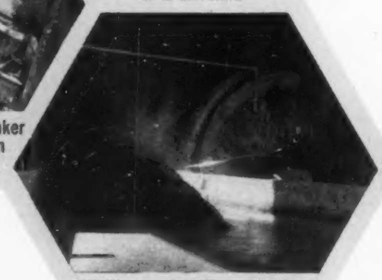

V.A. Wemco classifier, part of wet grinding system, lower bearing submerged in hot sludge.

Here's a report of our own experience with lithium-base grease under extreme industrial service conditions. Approximately 95% of the grease used in the plant of AMERICAN LITHIUM CHEMICALS, Inc., our subsidiary at San Antonio, Texas, is lithium-base, one-type grease. In fourteen months operation we have not been able to trace a single cause for bearing failure to the lubricant used. The on-the-spot photos above give graphic evidence of the rugged bearing service requirements in this plant where lithium ores are processed into high-grade lithium hydroxide, itself an important ingredient in lithium-base grease. Performance like this is why grease chemists, manufacturers, marketers and users all attest to the superiority of lithium-base... the *one* grease in place of *many* for efficient and economical operation.

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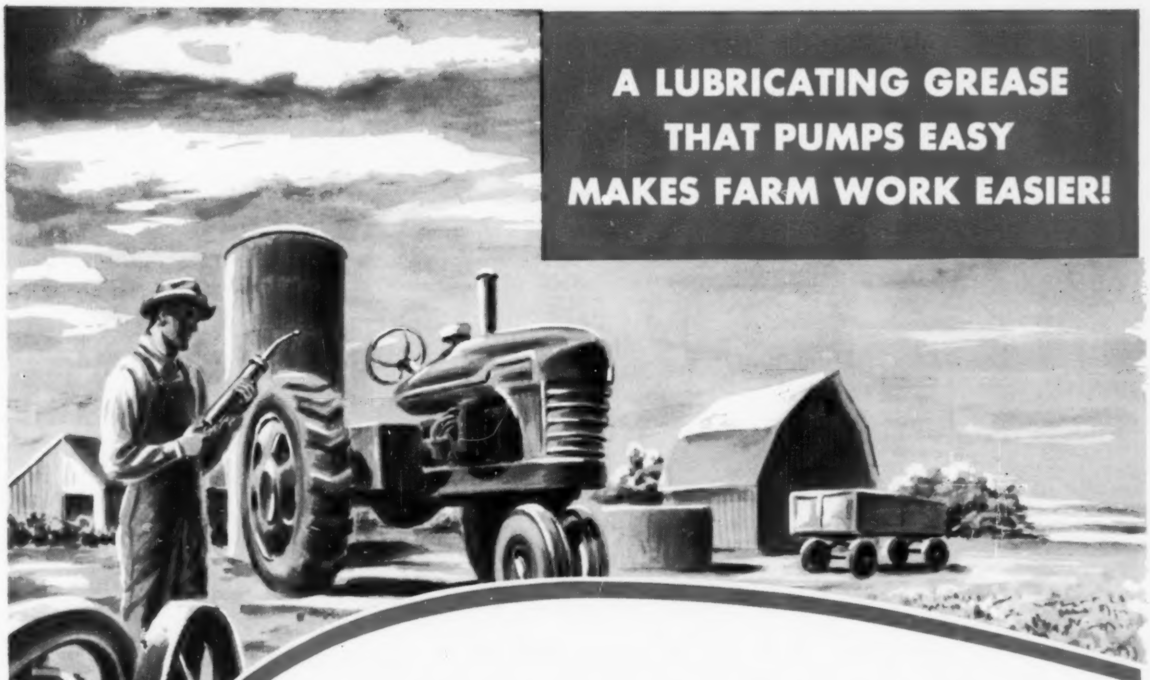

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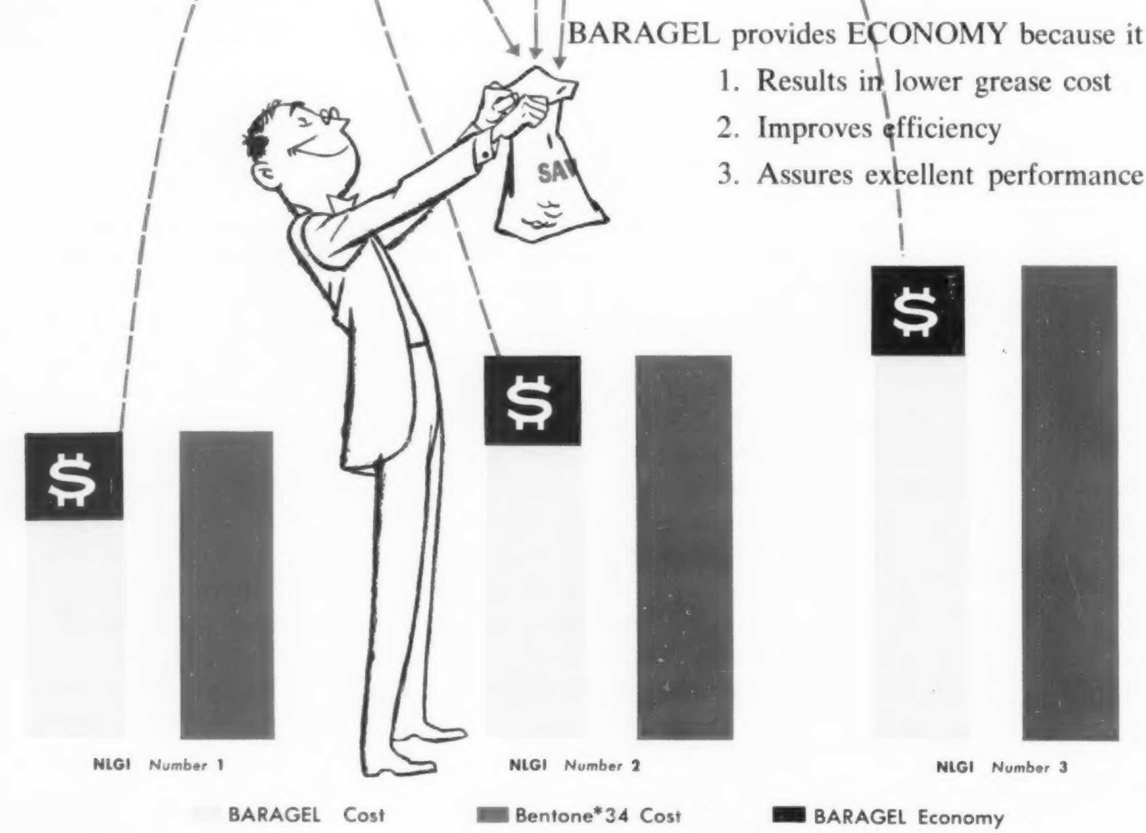

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B 5838

NLGI PRESIDENT'S PAGE

By R. CUBICCIOTTI, *President*

A Time to Improve

It would be flying in the face of facts to claim that the effects of current business conditions are not being felt by the grease lubricating industry as a whole. Although we may understandably be inclined to think of the business picture in terms of cutbacks in machinery orders or automobile production, it should be borne in mind that our nation's economic problems are not isolated phenomena; they are national in scope.

But whether or not we attribute the state of affairs in our own industry to the situation of the country as a whole is beside the point. Nor is it of any consolation to us that other industries are being affected as well. We must studiously abstain from the kind of wishful thinking that only prompts one to sit back and wait for things to happen.

It would be far healthier for the individual members of the Institute, as well as for our entire industry, if we were to look upon the current state of affairs as an unequalled opportunity to determine just how we can, either individually, or as a group, improve our position.

Naturally, at a time like this, one looks at his line of products and considers carefully whether it is up-to-date technologically and whether it is packaged in a functional, as well as attractive, manner. While, as an industry, we have a right to be proud on these scores, it does not follow that improvements are not possible.

Much more to the point, we should ponder on the effectiveness of our selling *at every level between manufacture and ultimate consumption.*

To take only one of the various routes by which our products reach their point of ultimate consumption, let us consider the sequence manufacturer-distributor-retailer (be it service station, garage, or car dealer)-motorist.

Traditionally, in our industry, it has been the practice to deal with the matter by a series of selling situations, first between the manufacturer and the distributor, then between the distributor and the retailer, last between the retailer and the motorist.

But such a chain is only as strong as its weakest link, and we are just plain lucky if each of the steps enumerated is equally effective. Furthermore, there is only one point at which the consumption of lubricating greases can actually be increased (and not diverted from one manufacturer to another) and that is between the retailer and the motorist.

Alas, that is the weakest link in the chain. For many reasons, some unknown, the others too complex to treat within this limited space, many retailers are simply *not* selling their quota of lubrication jobs.

While the Institute has under consideration a survey to determine some of the reasons for this failure, and while it is hopeful of developing some form of industry-wide promotion aimed at this specific weakness, no member can afford to wait upon a program which must necessarily take a long time to be completed. Surely each of us knows enough about his business to think up and execute *now* some ideas which will produce better selling at the retail level, because it is important for us to realize that more creative efforts on the part of every member of the National Grease Lubricating Institute are a must if we are to improve the chances of a speedier return "to normal" in our own industry, and thereby contribute to a return of prosperity throughout the country. ■

Future Meetings

MAY, 1958

19-20 API Division of Marketing, Lubrication Committee Meeting, Point Clear, Ala.

21 NLGI Board of Directors meeting, Hibernia National Bank board room.

21-23 API Division of Marketing, Midyear Meeting, Roosevelt Hotel, New Orleans

22-23 API Division of Production, Pacific Coast District Meeting, Biltmore Hotel, Los Angeles.

JUNE, 1958

8-13 API Division of Production, Midyear Committee Conference, Hollywood Beach Hotel, Hollywood, Fla.

8-13 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

22-28 ASTM 61st Annual Meeting, Hotel Statler, Boston, Mass.

SEPTEMBER, 1958

8 NLGI Board of Directors meeting, New York City, location to be announced.

10-12 National Petroleum Association, Atlantic City, N. J.

28-30 IOCA Eleventh Annual Meeting, Palmer House Hotel, Chicago, Ill.

OCTOBER, 1958

13-15 ASLE-ASME Joint Lubrication Conference, Hotel Statler, Los Angeles, Calif.

20-22 SAE National Transportation Meeting, Lord Baltimore Hotel, Baltimore, Md.

22-24 SAE National Diesel Engine Meeting, Lord Baltimore Hotel, Baltimore, Md.

27-29 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

NOVEMBER, 1958

5-6 SAE National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

FEBRUARY, 1959

2-6 ASTM National Meeting, William Penn Hotel, Pittsburgh, Pa.

***MARCH, 1959**

3-5 SAE Passenger Car, Body, and Materials Meeting, Sheraton-Cadillac, Detroit, Mich.

*Tentative.

APRIL, 1959

21-23 ASLE Annual Meeting and Exhibit, Hotel Statler, Buffalo, New York.

JUNE, 1959

14-19 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

OCTOBER, 1959

11-16 ASTM National Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

19-21 ASLE-ASME Joint Lubrication Conference, Sheraton-McAlpin Hotel, New York, N. Y.

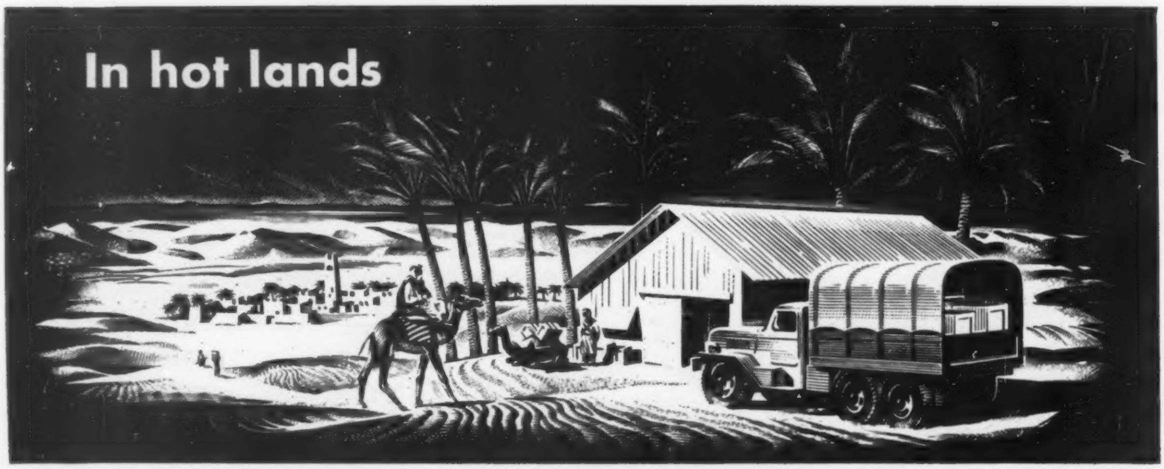
26-28 NLGI ANNUAL MEETING, New Orleans, La.

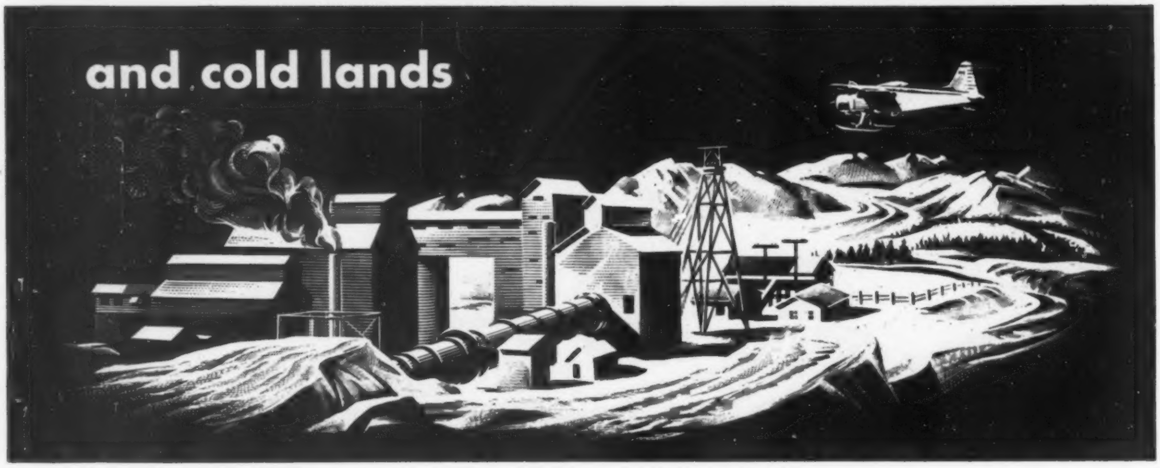
FEBRUARY, 1960

1-5 ASTM National Meeting, Hotel Sherman, Chicago, Ill.

APRIL, 1960

19-21 ASLE Annual Meeting and Exhibit, Netherland-Hilton Hotel, Cincinnati, Ohio.





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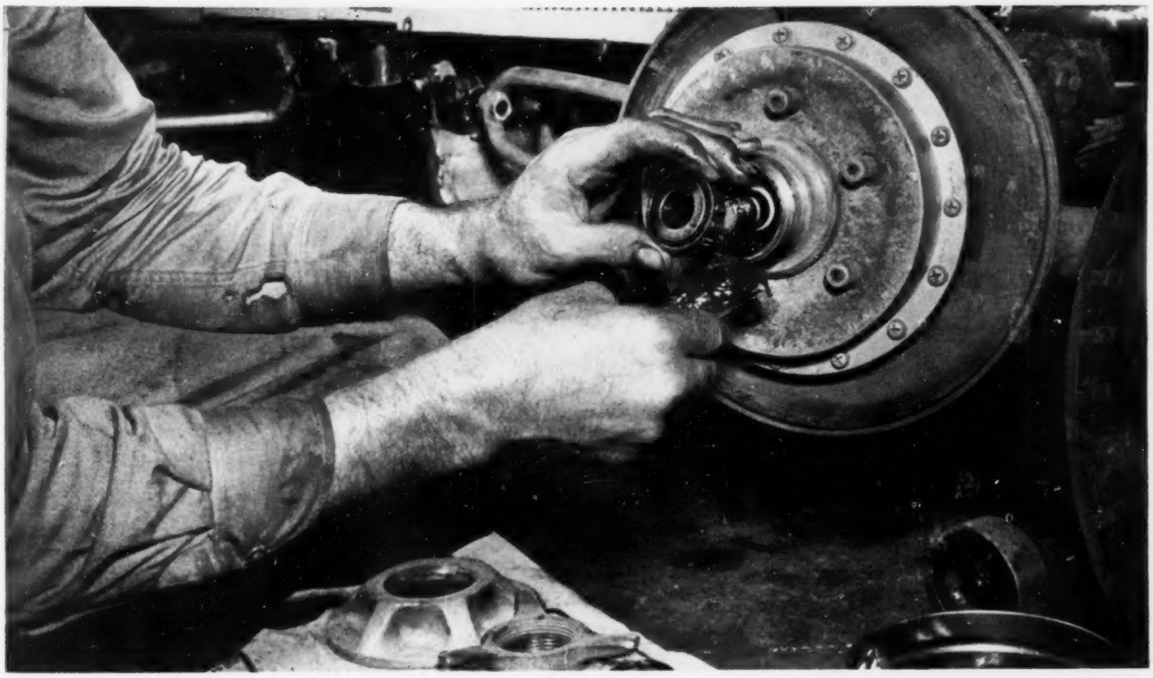

nlgi spokesman

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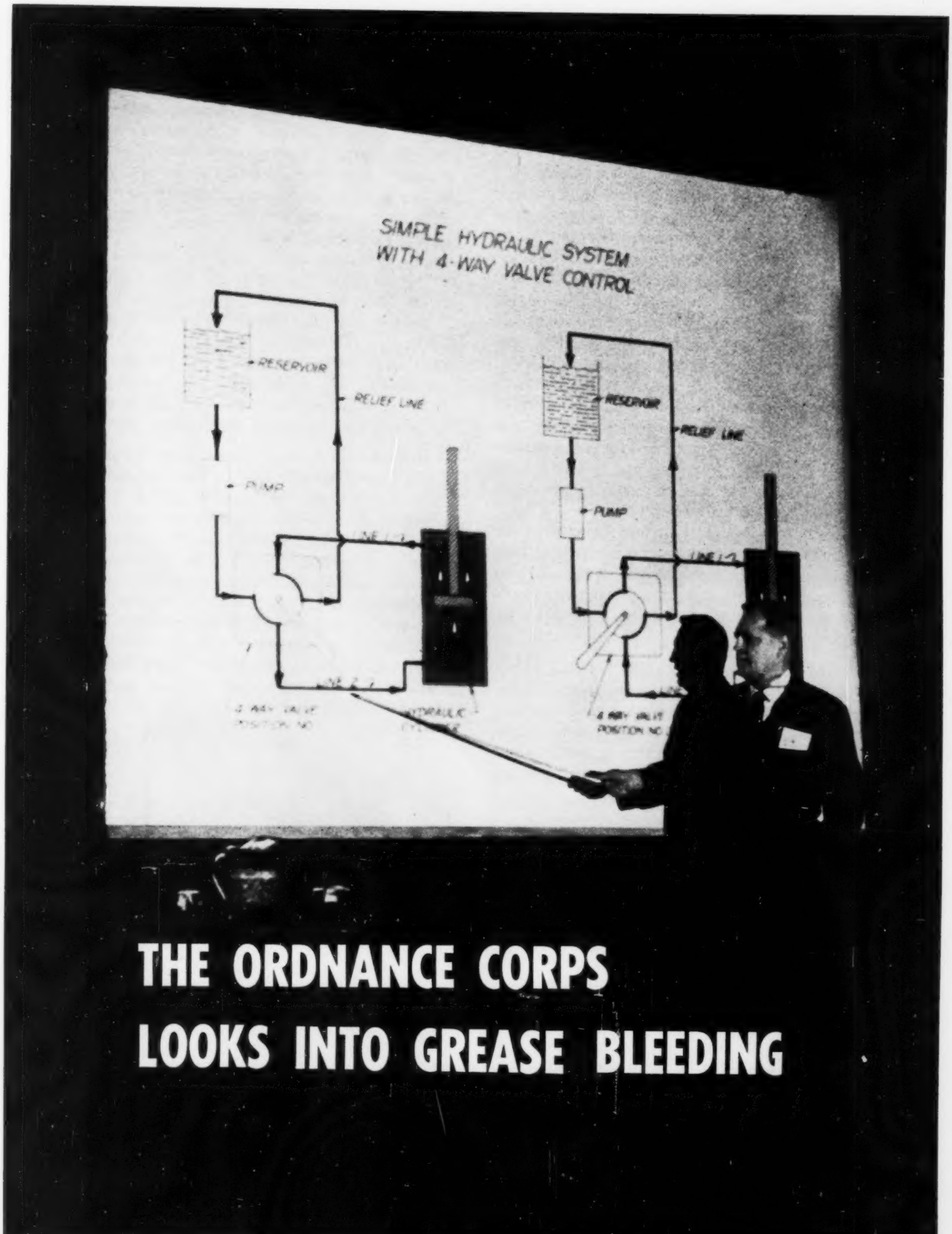
IN THIS ISSUE

THE COVER

SHOWN on our cover is the final scene from a dramatized workshop given at the 1957 NLGI annual meeting, with participants holding up the symbolic key points stressed during the presentation. From the left are moderator H. A. Mayor, Jr., and marketers Bert Melchar, Jack Hodges, Oliver Elliott and Walt Pannell, who proved that product promotional efforts can sell grease, as outlined in the article "Selling the Magic Film Promotionally," which begins on page 86. Not shown in the script are the props and scenery, but the selling precepts given are of value to members of the lubricating grease industry.



THE ORDNANCE CORPS LOOKS INTO GREASE BLEEDING

Presented at the NLGI 25th annual meeting in Chicago, October, 1957

By S. F. CALHOUN
Rock Island Arsenal

Synopsis

The Ordnance Corps became concerned with grease bleeding when reports of damage to tires and of "excessive" bleeding in storage were received. A test for bleeding was devised which correlated well with observations of grease bleeding from the field. A study of some of the parameters affecting grease bleeding was undertaken, with the aim of establishing some mathematical relationships. Factors which had an effect were found to be: soap type and concentration, oil viscosity, pressure, temperature, fiber size structure and dispersion, thickness of the grease layer and fineness of the supporting screen. Lack of any definite mathematical relationship in most cases would seem to indicate that some unknown factor, possibly involving the micelle structure of the thickening agent, has a major influence in bleeding.

The effect of oil loss resulted in an increase in the apparent viscosity and consistency of the grease. Radioactive tracer studies of oil movement during bleeding indicated that the oil-soap ratio was maintained uniformly throughout a grease when gravity forces alone were acting. Application of pressure or suction to the grease disturbed this uniformity.

THE FACT THAT oil separates from greases has no doubt been known since greases were first made. The reasons for this separation and its effects upon the quality of the grease are not fully known today. The earliest known attempt to study this phenomena was in 1933 when Herschel[1] described a test method involving pressure. Soon various government specifications were including bleeding tests generally employing perforated or wire gauze cones to hold the grease and weighing the oil to determine the separation. Georgi[2] in 1943 made a survey of such methods and a CRC[3] report a year later concluded: "The cone oil bleeding test as it is now set up is not suitable for evaluating the tendency of greases to separate oil in storage, either in bulk or in equipment in which the grease may be used." In spite of this generally accepted inadequacy of the cone type of tests they are still present in many grease specifications.

The Ordnance Corps became alarmed over the problem of oil separation in greases when reports of damage to tires were received. This damage was noted when oil from grease packed constant velocity joints of stored vehicles dripped on the sidewalls of the tires. Simultaneously reports were received on what was termed "excessive" bleeding involving greases stored in the original containers. Figure 1 shows a drum of grease after several months storage. The surface of the grease is cracked, it has shrunk away from the sides of the container, and in its tilted position the separated oil shows clearly at the lower edge. Figure 2 shows a drum from which some of the grease has been used. The separated oil, collected in the pockets of the rough surface, is indicated by arrows. While the amount of oil thus collected was not large, the 100-pound drum yielded slightly more than one pound, it impressed field personnel as "excessive" and resulted in questions as to whether to use or discard the grease.

Rock Island Arsenal was assigned the task of designing a more realistic test for oil separation than was currently available. It was desired that the test require a minimum of time and give a sufficient spread in results to provide a sound basis for differentiating between the various greases. Also of prime importance the test should give results which correlated with field experience. After a period of development during which various methods were considered, a method utilizing air pressure was designed which met the desired requirements. This test, Federal Standard No. 791-332, is fully described therein and also in the ASTM bulletin for December 1955.[4]

FIGURE 1. Bleeding in original containers during storage.

TABLE I

Correlation Studies of Observed and Experimental Grease Bleeding

Grease No.	*Observed Bleeding in Container*	*Test Results Air Pressure Method As Per Cent*
1	Slight	6.82
3	Slight to moderate	6.85
4	Slight	5.47
6	Slight	5.93
7	Slight to moderate	8.19
8	Slight to moderate	7.48
11	Moderate	12.55
12	None to slight	5.09
13	Excessive	17.28
14	Slight	5.84
15	Excessive	19.08
16	Moderate	10.92
17	Moderate	10.12
18	Slight	5.82

Correlation between this text and field experience concerning bleeding in the containers was obtained at this Arsenal in two ways. The first was by observation in this laboratory or reported by field personnel of observed bleeding in the container. These were usually made upon opening a drum or a pail of grease which had been in storage for a period of time. Since no attempt was made to determine the amount of oil collecting in cavities or depressions in the grease, these observations are purely qualitative. Comparison with

FIGURE 2. Bleeding observed in a grease drum kept in storage after removal of part of the grease (note white arrows).

quantitative results of the air pressure test shows fairly good correlation which is shown in Table I.

For the second study the air pressure results were compared with results of the three cone 35 pound pail bleeding tests.[5] The cone test, which consists of placing three wire mesh cones of specified dimensions in the surface of a 35 pound pail of grease, is presumed to simulate the bleeding of greases stored in various containers. Three greases were selected to represent a high, medium and low bleeding type. The results of the cone method in milliliters compared with the air pressure method in grams are shown in Table II and indicate the degree of correlation obtained generally by this method.

TABLE II

Comparison of the Three Cone 35 Pound Pail and the Air Pressure Test Results

Grease	*3 Cone Pail 1 Week—in Ml*	*Air Pressure 24 Hour—in Grams*
A	8.72	1.53
B	33.6	10.6
C	88.4	21.2

Considerable work has been done by a panel under the chairmanship of Dr. B. B. Farrington, CRC Project No. CLV-4-54, in comparing various bleeding tests and establishing a correlation "with field experience." The three cone, thirty-five pound pail test was used by this group as indicative of bleeding in static storage.

Although many of the early studies of grease bleeding were concerned with testing methods, several attempts to establish parameters are on record. Farrington and Humphreys[6] established that several factors were responsible for oil separation from greases. Their findings include, oil viscosity, pressure on the grease, nature of the soap base, fineness of the soap fiber, and quantity of oil in the grease. Roehner and Robinson[7] observed that oil separation was a function of the grease structure, oil viscosity, time, pressure, temperature and structure of the retaining agency. Browning[8] states that the oil retaining properties of a grease could be due to the attractive influence of the soap fiber surfaces extending through many thicknesses of oil molecules. If this observation is true, anything that would produce a finer fiber and a more uniform distribution of soap fibers should increase the oil holding properties of a grease and thus decrease the amount of oil separation.

The Shell Development Company[9] obtained better control of bleeding and other properties by the use of anisometric (uneven) fibers. Their contention is that the oil is retained in a grease by the capillary attraction of the gelling agent and that bleeding occurs when the liquid head due to gravity exceeds the ability of the capillary to hold the oil. By the use of aniso-

metric fibers they obtained the fine structure to increase capillary attraction and also the mechanical stability attributed to the coarse fibers. They claim the resulting grease to have high mechanical stability and to be highly resistant to bleeding.

H. R. Kruyt[10] contends that the loss of fluid from a gel is due to syneresis. Gels, especially the lyophobic type, are fundamentally unstable since they have formed the minimum number of contact points upon gelling. Upon standing, a greater number of contact points are formed, thus resulting in a contraction of the dispersed phase and consequent expulsion of a part of the intermicellar fluid. In this way the free energy is lowered. Syneresis is promoted by all factors which promote coagulation, such as, addition of alcohol, increase in temperature, or addition of an electrolyte. Elliott[11] explains syneresis, or the separating of oil from a grease, as being due to the slow adjustment made by a metallic soap-hydrocarbon system in order to establish stability.

Coincident with their study of high speed bearings Wright Air Development Center[12] investigated the loss of oil from a grease while under the influence of centrifugal force. Their findings may be summarized as follows:

1. The rate at which oil is lost is inversely proportional to the viscosity of the oil.

2. The rate and amount of oil loss decreases with increasing polarity of the oil.

3. The rate and amount of oil loss is proportional to the inverse concentration of the gelling agent.

4. The change in the amount and rate of oil loss with temperature follows the Arrhenius relationship with an activation energy of 7-10 Kcal/mol.

5. The change in the amount and rate of oil loss with gravitational force shows an Arrhenius type relationship between the logarithm of the ratio of oil loss and the inverse of the gravitational force.

6. The data on the rate of oil loss from a grease show that as the concentration of the gelling agent is increased in either a soap or an inorganic gelled grease the rate of oil loss changes from a rate that is proportional to the concentration of oil in the grease (first order kinetics) to a rate that is independent of the concentration of oil in the grease (zero order kinetics).

These findings seem to indicate that the loss of oil from a grease is primarily a rate phenomena. From the standpoint of bearing lubrication the rate at which oil is released to a bearing has a greater effect upon the length of time a grease will lubricate than the total amount of oil available.

Attempts to control oil separation in greases by the use of additives are on record. Evans[13] found that oleic acid, palmitic acid, and certain hydrocarbons, when added to greases in small amounts, tended to retard syneresis. Larger amounts retarded gelling. Small amounts of different soaps in admixture had an effect upon syneresis. Some hydrocarbons tended to accelerate oil loss. The acceleration or retardation seemed to be related to the number of methylene groups present in the additive. Patents[14,15] have been issued for the control of oil separation by the use of specified additives. McDonald and Dreher[16] claim that the effect of additives to lessen bleeding is dependent upon the nature of the oil used and the processing conditions. Some additives are only effective in a particular grease manufactured according to a definite procedure. Many patents[17,18,19,20] have been issued for the control of oil separation by special processing methods and heat treatment. Boner[21] lists several examples of the use of various additives such as metallic soaps, sulfonates, and naphthenates to retard oil separation in various types of greases.

An investigation was undertaken at Rock Island Arsenal to study and quantitatively evaluate the various factors known to have an influence upon bleeding and to search for and study any hitherto unknown ones. Because of their pertinency to the Ordnance Corps, a primary consideration was given to greases secured under Specification MIL-G-10924 (Amendment 2). When the parameter under consideration could not be obtained by use of these greases, others were made in the laboratory to provide the necessary qualities. Descriptions of these greases are given in the appropriate sections. The MIL-G-10924 greases were secured in 35 pound quantities in order to have sufficient grease for all contemplated tests including an aging study. Certain physical characteristics of the greases which were of value in this study were determined by ASTM or Federal Standard No. 791 Methods and are listed in Table III.

Three methods were used to determine the oil separation. They were: the air pressure method, Federal Standard No. 791-322, a test tube method,[1] and a cen-

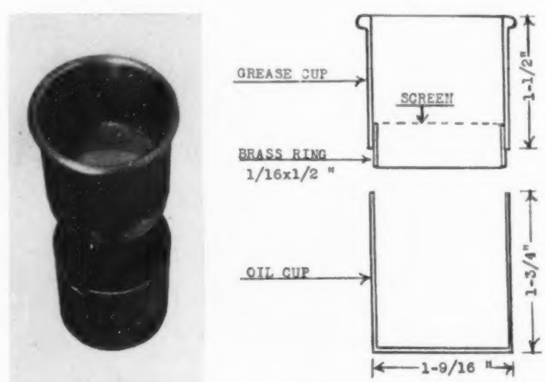


FIGURE 3. Centrifugal oil separation apparatus diagram.

TABLE III

Characteristics of Mil-G-10924 Greases Used in This Investigation

Grease No.	Penetration Unworked	Penetration Worked	Soap Type	Soap Per Cent	Oil Viscosity-Cs 100	Oil Viscosity-Cs 210	Viscosity Index
1	270	295	Calcium	11.8	11.67	2.64	52
2	306	297	Lithium-Calcium	11.8	17.21	3.43	71
3	307	315	Calcium	9.2	16.26	3.34	75
4	281	290	Calcium	16.8	16.28	3.35	78
5	285	281	Calcium	10.4	14.67	2.91	24
6	296	298	Lithium-Calcium	11.6	18.84	3.71	86
7	297	306	Calcium	10.8	17.62	3.49	73
8	256	270	Calcium	11.6	16.00	3.20	54
9	318	325	Lithium-Calcium	12.0	14.79	3.02	47
10	290	291	Calcium	13.0	13.67	3.05	83
11	323	321	Lithium-Calcium	11.4	16.83	3.55	99
12	279	299	Lithium	12.6	17.06	3.44	76
13	290	305	Calcium	12.4	14.25	2.93	41
14	320	314	Lithium-Calcium	8.4	15.28	3.23	77
15	307	268	Calcium	12.6	13.62	2.96	66
16	302	290	Lithium-Calcium	11.2	14.10	3.05	72
17	290	287	Lithium-Calcium	11.6	14.31	3.09	74
18	785	290	Calcium	10.0	15.50	3.36	96

TABLE IV

Bleeding Results on Greases in Weight Per Cent

Grease	Test Tube	Air Pressure	Centrifugal	Observations on Containers
1	0.60	7.12	8.93	Slight
2	0.97	12.83	16.05	Moderate
3	1.29	18.71	19.60	Moderate
4	0.57	6.89	10.42	Slight
5	0.89	11.59	8.9	Slight
6	0.87	16.99	14.21	Moderate
7	0.79	8.19	7.27	Slight
8	0.57	6.81	7.68	Slight
9	1.24	13.6	18.23	Moderate
10	0.75	6.95	7.57	Slight
11	0.84	14.71	18.88	Moderate
12	0.24	1.70	2.56	Very slight
13	0.61	5.09	6.40	None
14	1.57	17.28	18.64	Large amount
15	0.70	5.84	8.57	Slight
16	0.77	10.96	11.73	Slight
17	0.97	10.09	10.81	Slight
18	0.68	11.61	11.09	Slight

trifugal method developed at Rock Island Arsenal and hitherto unpublished. The apparatus used for the centrifugal method is shown in Figure 3. It was made from the metal shield for a tapered oil tube cut to the dimensions shown. A 100 mesh screen was soldered to a brass ring and then the assembly soldered into the bottom of the grease cup. The bottom portion of the shield, which forms the oil cup, fits snugly over this brass ring to form a compact assembly. The 100 mesh screen was covered with a No. 589-1H, S&S filter paper cut to fit and approximately 15 grams of grease weighed to the nearest 0.001 gm placed in the cup. The oil cup was attached and the assembly placed in a large metal shield of an International No. 2 centrifuge. Sponge rubber rings held the assembly centered in the shield. After some experimentation the test conditions were established at 1250 rpm for one hour at ambient temperatures which ranged from 78-80°F. The results obtained for all methods used are shown in Table IV. It is apparent that the three methods correlate closely and that the centrifugal method approaches the air pressure for magnitude.

Since these greases are different from those included in Table I and conditions were more capable of control, the general observations of bleeding in the container were repeated. These observations were made upon first opening the pail upon receipt from the supplier and repeated at the end of the 12 and 24 month periods. These observations included in the last column of Table IV illustrate the degree of correlation obtained with the quantitative methods.

Examination of the air pressure oil separation in Table IV shows better than a tenfold spread in results. The other methods also show a wide spread. Since the greases were all made to meet the same specification and from oils of nearly similar properties the cause of this wide bleeding spread evidently lay in compositional or structural differences of the gelling agent. Arranging the greases in order of descending amount of bleeding eliminated oil viscosity, viscosity index, or soap percentage as important factors in oil loss in these

instances. One possible factor was emphasized by this arrangement and is illustrated in Table V. The greases made of mixed lithium-calcium soaps, with but two exceptions composed the highest 50 per cent of the greases in regard to bleeding. The lone lithium soap grease was lowest in bleeding by all methods as can be seen by reference to Table IV.

In a further study of this factor, fourteen greases were made in the laboratory. Information concerning these greases is included in Table VI. They were all made from the same oil stock, an 80 SUS, 108 V. I., solvent refined oil. The soaps for all except B-1 were made in situ.

TABLE V
Effect of Soap Type Upon Bleeding
Mil-G-10924 Greases

Grease	*Soap*	*Air Pressure Method Bleeding, Per Cent*
3	Lithium-Calcium	18.71
14	Lithium-Calcium	17.28
6	Lithium-Calcium	16.99
11	Lithium-Calcium	14.71
9	Lithium-Calcium	13.60
2	Lithium-Calcium	12.83
18	Calcium	11.61
5	Calcium	11.59
16	Lithium-Calcium	10.96
17	Lithium-Calcium	10.09
7	Calcium	8.19
1	Calcium	7.12
10	Calcium	6.95
4	Lithium-Calcium	6.89
8	Calcium	6.81
15	Calcium	5.84
13	Calcium	5.09
12	Lithium	1.70

The soap percentage was calculated at 10 per cent, but was raised to 12 per cent in the case of B-2, B-11 and B-12 in an unsuccessful attempt to lower the penetration. Study of the bleeding results shows that of the four greases made from commercial 12-hydroxystearic acid, the mixed soap grease No. B-9 had a lower bleeding rate than either the lithium soap grease B-3, the sodium soap grease B-12, or the calcium soap grease B-14. Comparing the greases made with the glyceride of 12-hydroxystearic acid, B-7 and B-10 favors the lithium soap grease. Evidently there is some unknown structural factor outweighing any compositional effect in these cases. Study of other data in the table fails to indicate any pronounced effect due to compositional differences.

In an attempt to evaluate the effect of oil viscosity and soap percentage upon the bleeding under more controlled conditions the following investigation was carried out. A series of greases was made up from oils of 80, 100 and 150 SUS at 100° F and containing 8, 10, 12, and 14 per cent of a preformed lithium stearate soap. The conditions of manufacture were kept as nearly identical as possible. The bleeding was determined by the air pressure method under standard conditions. Pertinent characteristics of the greases and their bleeding percentages are given in Table VII. It is quite evident that increasing the soap content or the oil viscosity results in a decrease in the oil loss. This is shown to better advantage in the graphs of Figure 4 and Figure 5. Figure 4 shows the per cent bleeding plotted against the oil viscosity. The oil loss is inversely proportional to the viscosity. Figure 5 shows bleeding plotted against soap concentration in per cent. Again it is apparent that the oil loss is indirectly proportional to the soap content. Mathematical relationships are not very good in either case due probably to insufficient data or other factors which are not accounted for.

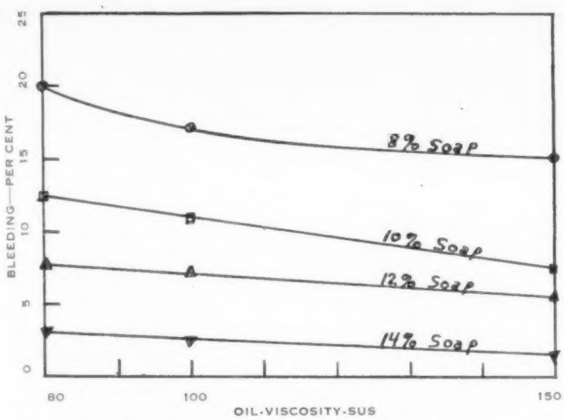


FIGURE 4. Relationship of bleeding to that of oil viscosity.

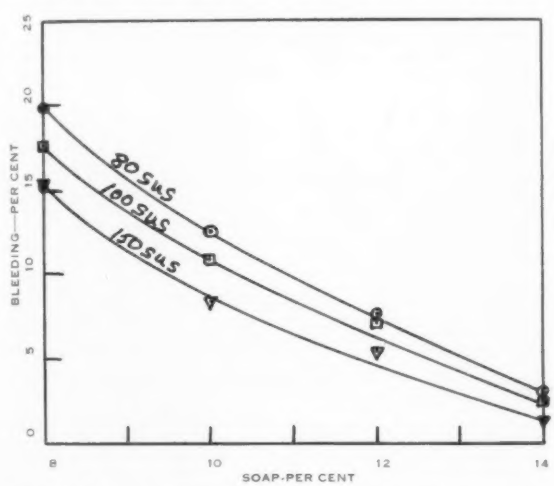


FIGURE 5. Relationship of soap content to oil separation.

TABLE VI

Effect of Soap Type Upon Bleeding (Laboratory Greases)

Grease	*Soap Type*	*Source of Fatty Acid*	*Pen.*	*Air Pressure Bleeding Per Cent*
B-1	Lithium	Preformed lithium stearate	290	9.16
B-2	Lithium	Eastman pure stearic acid	330	13.2
B-3	Lithium	Commercial 12 hydroxy stearic acid	271	8.2
B-4	Lithium	Commercial castor wax	281	10.2
B-5	Lithium	Methyl Ester of 12-hydroxy stearic acid	274	7.0
B-6	Lithium	Modified stearic acid	270	6.3
B-7	Lithium	Glyceride of 12-hydroxy stearic acid	264	8.7
B-8	Lithium	Purified 12-hydroxy stearic acid	276	14.5
B-9	Lithium-Calcium	Commercial 12-hydroxy-stearic acid	250	4.4
B-10	Lithium-Calcium	Glyceride of 12-hydroxy-stearic acid	290	11.3
B-11	Sodium	Commercial stearic acid	330	10.8
B-12	Sodium	Commercial 12-hydroxy-stearic acid	307	13.4
B-13	Calcium	Commercial stearic acid	245	5.07
B-14	Calcium	Commercial 12-hydroxy-stearic acid	288	10.06

TABLE VII

Effects of Soap Concentration and Oil Viscosity Upon Oil Separation, Preformed Lithium Stearate Soap, Air Pressure Method

SUS Oil Viscosity	*Soap Per Cent*	*Penetration*	*Bleeding Per Cent*
80	8	342	19.9
100	8	331	17.6
150	8	322	15.3
80	10	317	12.5
100	10	322	10.9
150	10	296	8.4
80	12	289	7.6
100	12	288	7.4
150	12	270	5.5
80	14	262	3.0
100	14	256	2.5
150	14	250	1.3

The increase in bleeding as the temperature is increased is a well known phenomena. It could be explained on the basis of the decrease in viscosity of the oil as the temperature is increased. Temperature increase could also result in the weakening and breaking of some of the contact points in the soap structure, thus increasing the micellar space with resultant loss of holding power. This view is supported by the work of Hotten and Birdsall[22] who found that the phase changes which occurred in a grease as the temperature increases were mainly responsible for the increased oil separation. Other factors which they observed as having a complicating effect upon oil separation with temperature increase were the nature of the soap cation and the degree of saturation, substituents, and molecular weight of the soap anion.

Two methods were used in gathering data for this study in the laboratory. The test tube method was used at 100F, 130F and 160F and the air pressure method at 77F, and 120F on the MIL-G-10924 greases. The results are found in Table VIII and show that an increase in temperature always resulted in an increase in bleeding. The increase was not uniform, however, and varied with the different greases, and with the same grease as the temperature increased. Similar results were obtained when greases made in this laboratory were examined by the test tube method. The results are shown in Table IX. Again the increase in oil loss is not proportional to the temperature increase and varies widely among the different greases. Examination of Table IX indicates that the oils of lower viscosity index were affected to a greater extent by the same temperature change. This can be explained on the basis that the lower viscosity index oils are thinned to a greater extent by the same temperature increase and thus lose oil more readily. Examination of the results of the MIL-G-10924 greases given in Tables VII and their viscosity indices from Table III do not fully support this observation. Evidently unknown factors are operating to complicate the temperature effects.

Several investigations concerning the effect of pressure upon grease bleeding have been made.[1,4,7] These have all been primarily concerned with developing a test for bleeding and quantitative studies are lacking in the literature. It seems to be an accepted fact that pressure increases bleeding and industrial users of pressure lubricating equipment have taken this inconvenience as a matter of course. It was decided to include in this study an investigation designed to supply some information concerning the relationship between bleeding and applied pressure.

TABLE VIII

Effect of Temperature Upon Bleeding, MIL-G-10924 Greases—Results in Weight Per Cent

	Test Tube Method					*Air Pressure Method*		
Grease	*100F*	*130F*	*Per Cent Increase*	*160F*	*Per Cent Increase*	*77F*	*120F*	*Per Cent Increase*
1	0.60	0.96	60	1.61	169	7.12	8.68	21.9
2	0.97	2.10	113	3.24	234	12.83	15.4	20.0
3	1.29	2.02	57	4.16	222	18.71	22.6	20.8
4	0.57	1.26	121	1.95	243	6.89	12.1	75.3
5	0.89	2.44	174	3.25	265	11.59	15.0	22.7
6	0.87	1.63	87	3.14	262	16.99	21.2	24.8
7	0.79	1.39	76	1.76	122	8.19	10.9	32.9
8	0.57	1.27	122	1.83	222	6.81	10.14	48.9
10	0.75	1.12	49	1.72	129	6.95	9.5	36.4
12	0.24	0.57	137	0.73	204	1.70	3.61	112.3
13	0.61	1.38	126	0.97	59	5.09	9.28	82.6
16	0.77	2.00	160	2.75	258	10.96	16.2	46.9
17	0.97	1.90	96	2.37	258	10.09	11.8	16.8
18	0.68	1.02	50	2.09	208	11.61	12.85	10.7

TABLE IX

Effect of Temperature Upon Bleeding Laboratory Greases, Test Tube Method—Oil Separation Per Cent

Oil	*Soap Per Cent*	*100F*	*130F*	*Per Cent Increase*	*160F*	*Per Cent Increase*
80 SUS	8	3.51	6.75	92	12.7	382
108 V. I.	10	2.15	3.71	72	8.38	289
	12	1.12	2.56	129	6.44	475
100 SUS	8	2.39	4.41	84.5	11.77	392
82 V. I.	10	0.85	2.79	228	7.12	740
	12	0.31	1.56	400	4.85	1465
150 SUS	8	1.57	3.83	142	6.67	325
66 V. I.	10	0.58	2.32	300	4.40	658
	12	0.32	1.05	236	3.30	940

Both the test tube and air pressure methods were utilized in this study. Some slight modifications were necessary in order to accomplish the desired results. For the test tube method some stainless steel disks were obtained. These disks weighed 20 grams each and were slightly smaller in diameter than the test tube. From one to three of these disks were placed on top of the grease in the test tube, thus subjecting the grease to an external pressure of 20, 40, or 60 grams. Weights in excess of 60 grams were not used, because of the large amount of oil which usually collected on top of the grease in such instances. It was impossible to collect this oil in anything approaching a quantitative basis. For some greases considerable oil collected on top when 60 grams was used which possibly accounts for some slight irregularities in the results for these weights.

In using the air pressure tester the pressures used were 0.35 psi and 0.70 psi. The higher pressure forced some of the softer greases through the 100 mesh screen. This necessitated use of a 200 mesh screen which was used for both pressures in this study.

TABLE X

Effect of Pressure Upon Bleeding Mil-G-10924 Greases Results in Weight Per Cent

	Test Tube Method				*Air Pressure Method*	
Grease	*0 gm.*	*20 gm.*	*40 gm.*	*60 gm.*	*0.35 psi*	*0.70 psi*
3	1.29	1.31	1.29	1.42	19.4	32.6
5	0.89	1.09	1.22	1.61	11.74	13.88
7	0.79	0.92	1.09	1.25	7.21	9.92
8	0.57	0.67	0.85	1.05	7.99	12.73
12	0.24	0.31	0.32	0.38	2.59	4.78
13	0.61	0.59	0.77	1.01	6.55	11.70
15	0.70	0.72	0.99	1.24	6.61	10.73
16	0.77	0.90	1.60	1.84	12.66	18.60

The results of this study are included in Table X. It is quite evident from this data that there is no proportionality between pressure and the increase in bleeding. Doubling the pressure does not mean a two fold

increase in bleeding. The actual increase in case of the air pressure method ranged from 37 to 84 per cent. The results from the test tube method are equally as varied.

In the preceding study it was noticed that the 200 mesh screen gave an oil loss which was greater than the loss from the 100 mesh screen for the same grease under identical conditions. Results, obtained at 0.35 psi and 77 F, are given in Table XI and show much non-uniformity among the various greases tested. This non-uniformity caused apparently by varying one physical factor, which by itself could have no effect upon either oil or soap, practically excludes any mathematical analysis. Attempted correlation with viscosities or viscosity indices gave contradictory answers. Grease No. 7 with the highest viscosity oil had the lowest increase in oil loss while grease No. 12 with the next highest viscosity oil, and the highest viscosity index, had the highest per cent of increase. Attempts to apply the laws of capillary to the screens were equally fruitless. Hence, until more precise studies are made any explanation of the greater oil loss from the finer screen must remain theoretical.

While checking some air pressure bleeding cells made by an apparatus manufacturer it was observed that they gave results which were lower than those obtained from testers made in this laboratory by practically the same percentage irrespective of grease used. When this phenomena was investigated it was discovered that the offending cells were in all cases slightly deeper than those made in this laboratory. In order to establish the relationship between oil separation and depth of the grease sample some test units were altered so that the depths of the grease could be varied. These testers were used to evaluate three greases, one each of a high, medium, and low bleeding rate as shown by previous tests. The depth of grease used was one-fourth, one-half and one inch. Other conditions were 100 mesh screen at 77°F and 0.35 psi for 24 hours.

The results given in Table XII show definitely that there is a decrease in the per cent of oil separation as the thickness of the grease layer increases. This does not mean that there was less weight of oil lost because the actual weight of oil separating did not vary to a great extent. The values given are weight percentages and on this basis there is a definite decrease in oil loss with an increase in thickness. Mathematical analysis of the data given in Table XIII discloses that the logarithm of the thickness ratio is inversely proportional to the ratio of the oil loss in per cent.

TABLE XI

Effect of Screen Dimensions Upon Bleeding
Mil-G-10924 Greases—Air Pressure Method

Grease	*Viscosity Cs @ 100*	*Viscosity Index*	*Bleeding in Per Cent 100 Mesh*	*200 Mesh*	*Per Cent Increase*
3	16.26	75	17.06	19.41	13.8
5	14.67	24	10.45	11.74	10.45
7	17.62	73	7.01	7.21	3.00
8	16.00	54	7.13	7.99	12.1
12	17.06	76	1.7	2.59	52.3
13	14.25	41	5.09	6.55	28.6
15	13.62	66	5.62	6.61	17.6
16	14.10	72	10.85	12.66	16.7

TABLE XII

Effect of Grease Thickness Upon Bleeding
Air Pressure Method, Bleeding in Per Cent

Thickness of Grease Layer	*Grease No. 6*	*Grease No. 8*	*Grease No. 12*
¼ inch	20.8	8.92	3.07
½ inch	15.26	6.30	1.81
1 inch	9.02	3.59	0.90

TABLE XIII

Mathematical Relationship of Grease Thickness to Bleeding

Grease Thickness	*Thickness Ratio*	*Log T.R.*	*Grease No. 6* Bleeding Per Cent	*Grease No. 6* Ratio	*Grease No. 8* Bleeding Per Cent	*Grease No. 8* Ratio	*Grease No. 12* Bleeding Per Cent	*Grease No. 12* Ratio
¼ inch	2.5	0.398	20.8	1	8.9	1	3	1
½ inch	5	0.699	15.3	0.7	6.3	0.7	1.8	0.6
1 inch	10	1.00	9.0	0.4	3.6	0.4	0.9	0.3

TABLE XIV

Effect of Grease Thickness Upon Bleeding
Centrifugal Method, Grease No. 8

Weight of Grease Grams	*Thickness of Grease Inches*	*Oil Loss Per Cent*
21.663	1	6.78
22.423	1	6.57
21.761	1	6.90
22.098	1	6.78
15.040	0.68	7.42
15.509	0.68	7.18
15.023	0.68	7.87
15.007	0.68	7.68
7.867	0.35	11.40
7.880	0.35	11.56

When the grease layer in the centrifugal method was varied the same trend was observed. The experimental results are given in Table XIV and the mathematical analysis in Table XV. The grease used was grease number eight, the medium bleeding grease used in the air pressure method. The mathematical relationship is not as close in this case as in the air pressure results indicating the possible presence of some unaccounted for factor.

TABLE XV

Mathematical Analysis of Data from Centrifugal Method

Grease Thickness	*Ratio*	*Log*	*Average Oil Separation*	*Ratio*
1 in.	10	1.00	6.8	0.6
0.68 in.	6.8	0.835	7.6	0.7
0.35 in.	3.5	0.544	11.5	1.0

TABLE XVI

Effect of Grease Thickness Upon Oil Separation—Test Tube Method

Grease Depth, Inches	*Grease Weight Grams*	*Oil Weight Grams*	*Weight Per Cent Oil*
2	43	2.146	5.0
4	83	3.041	3.7
6	130	4.941	3.8

As a further check upon the effect of grease depth upon oil separation, grease number eight was tested in the test tube apparatus. The tests were run at 130 F at atmospheric pressures for 72 hours. The results obtained are shown in Table XVI. It is quite evident that there is no relationship other than a general one between depth of grease and oil separation in this case. The temperature used or some other factor has evidently complicated the picture.

The effect of grease thickness upon oil separation is shown graphically in Figures 6 and 7. Figure 6 shows the effect of the same method, that of air pressure upon greases of different inherent bleeding tendencies. Grease number six, a high bleeder, is affected to a greater extent than the other two greases, number eight, an intermediate, and number twelve, a low bleeder. Figure 7 shows the effects of the three different methods upon grease number eight, the intermediate bleeder. The similarity of results and the effect of grease depth upon bleeding is readily apparent.

It is a common practice of grease makers to subject the grease to a milling or working procedure as one phase of the manufacturing process. This is intended to improve certain characteristics and to give a more uniform product. Standard Oil company of Indiana[22] has found that there is an optimum amount of such working or milling and that too many millings caused a deterioration in the grease. They claim that a limited number of millings, usually one or two, resulted in a better dispersion of the soap fibers and thus improved certain characteristics.

In order to study the effect of milling upon the bleeding characteristics several of the commercial and

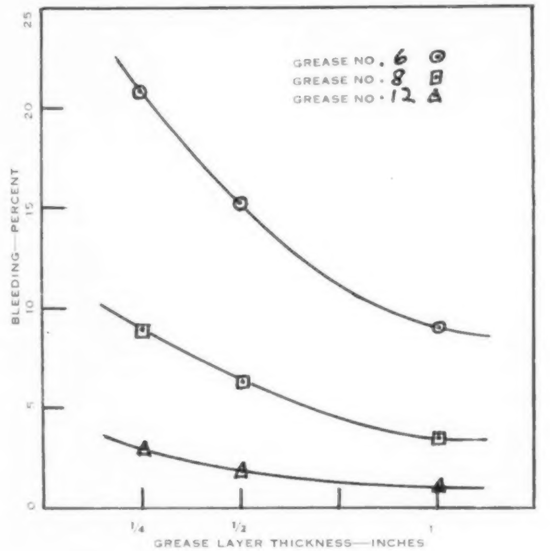


FIGURE 6. Effect of grease thickness upon oil separation.

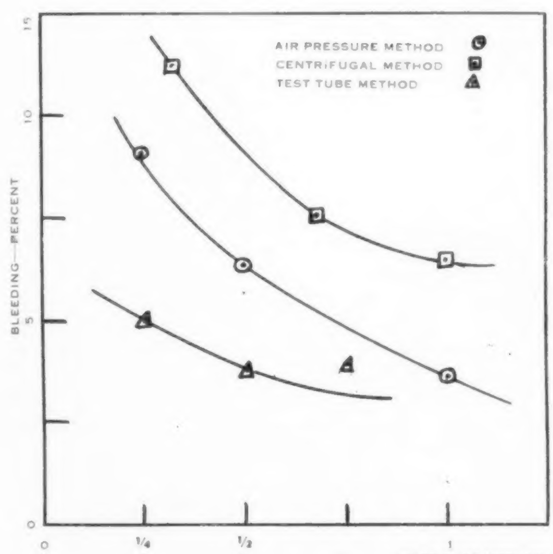


FIGURE 7. The effect of grease thickness upon oil separation, the comparison of three different methods.

laboratory made greases used in this study were subjected to extra millings. The commercial greases were given one pass through a Morehouse Model MG Mill with the stones set at 0.001 inch clearance. The laboratory made greases, which had been given one pass through the mill as part of the manufacturing process, were given two more passes under the same conditions as for the commercial greases. All millings were

TABLE XVII

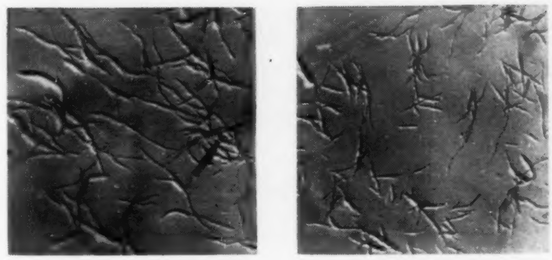
Effect of Milling Upon Oil Separation

	Original		*After Milling*	
Grease	*Penetration Unworked*	*Bleeding*	*Penetration Unworked*	*Bleeding*
2	306	12.83	265	8.37
3	307	18.71	282	12.28
5	285	11.59	280	7.26
6	296	16.99	276	8.38
7	297	8.19	285	6.82
9	318	13.60	263	6.56
11	323	14.71	304	14.61
14	320	17.28	304	13.21
16	302	10.96	290	10.39
B-3	271	8.20	267	7.28
B-4	281	10.22	285	9.14
B-5	274	7.0	262	6.1
B-6	270	6.33	342	7.24
B-7	264	8.74	275	9.05
B-8	276	14.5	270	8.55
B-9	250	4.4	249	3.64
B-10	290	11.3	310	11.26

carried out at ambient temperaturs. The bleeding was determined by the air pressure method within one week of milling.

The results given in Table XVII show that with but two exceptions the bleeding of the commercial greases was noticeably less after milling. In two cases, that of greases number six and nine, the bleeding after milling was less than half of its previous value. The laboratory made greases, here indicated by the B-prefix, were not affected to such an extent by the extra milling. Some breakdown was indicated in the case of grease B-6 which got considerably softer and bled more profusely. Grease B-7 was also affected similarly but to a lesser extent.

In an attempt to ascertain if the decrease in penetration and bleeding was associated with any noticeable change in fiber structure electron micrographs were made of some of the commercial greases. The electron micrographs of grease number nine is shown in Figure 8 and is representative of those obtained for greases which showed considerable change in bleeding. There is clearly some decrease in fiber dimensions and thus theoretically a better dispersion. The electron micrographs as taken do not show the fiber dispersion in a



UNMILLED MILLED

FIGURE 8. The effect of milling upon grease fibers.

grease, only the dimensions are discernable. No attempt to determine the length to width ratio of the fibers was made in this laboratory due to lack of personnel.

Further light upon the effect of fiber dimensions, or dispersion, upon bleeding of greases was obtained from the work of The Standard Oil company (Indiana) in their contract with the Ordnance Corps.[33] In their study of thixotropy they had prepared greases from a 100 SUS at 100°F mineral oil and containing 7 per cent of lithium 12 hydroxy stearate. By controlling manufacturing procedure they had obtained greases of different fiber dimensions. The average length to average width, $\overline{L}/\overline{W}$ of these greases had been carefully determined. Three of these greases together with their $\overline{L}/\overline{W}$ ratio and the bleeding results obtained on the air pressure apparatus were supplied to Rock Island Arsenal. These values together with the bleeding results obtained at Rock Island Arsenal by the air pressure method are given in Table XVIII. The results obtained on these greases indicate an increase in bleeding as the $\overline{L}/\overline{W}$ or coarseness of the fibers increases. This

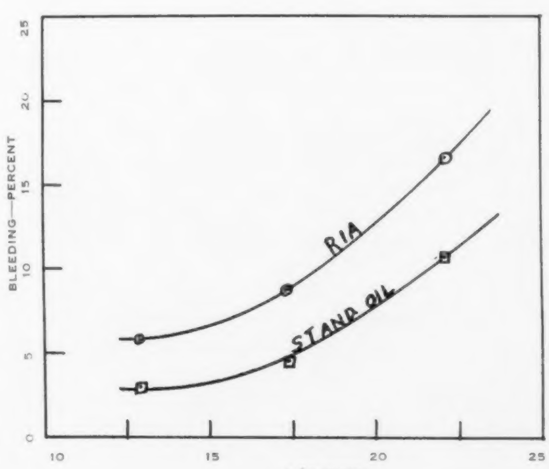


FIGURE 9. The relationship of bleeding to the L/W ratio.

relationship is shown in the graph of Figure 9 which contains results obtained by both Standard Oil and Rock Island. The good correlation between the two laboratories is clearly shown and the fact that the increase in bleeding is not directly proportional to the L/W ratio is also demonstrated. Results obtained by Standard Oil on other greases and included in their referenced report do not conclusively substantiate these findings and indicate that fiber dimensions provide only a partial answer to the bleeding question.

TABLE XVIII

Effect of Fiber Dimensions Upon Bleeding

Grease	*L/W*	*Standard Oil*	*Rock Island Arsenal*
Li-8	12.8	3.0	5.9
Li-10	17.3	4.5	8.6
Li-9	22.1	10.6	16.8

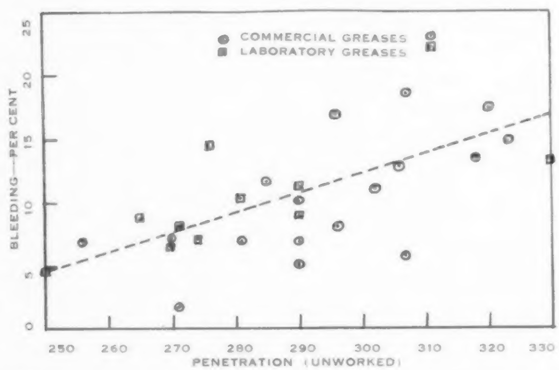


FIGURE 10. The effect of consistency upon bleeding.

Casual examination of the results in Tables III, VI, and VII reveals little if any relationship between bleeding and consistency, as determined by unworked penetration. When the penetrations and bleeding results of the commercial and laboratory made greases included in these tables are plotted against each other, the result shown in Figure 10 is obtained. The dotted line drawn approximately centerwise of the plotted points does, however, indicate some slight correlation between the two parameters. Using the data from these tables the coefficient of correlation was calculated and resulted in the value of 0.23 for the laboratory made greases and 0.26 for the commercial greases. Perfect correlation should give a coefficient of 1.00.

This practically negligible correlation, together with the similar results obtained in the study of other parameters, tend to substantiate the theory that a major factor in bleeding is the fiber or micelle structure of a grease. Present techniques present only a partial and perhaps inaccurate picture of this structure. Until a better knowledge of grease structure is available the real cause of many grease characteristics must remain obscure.

The effect of aging upon bleeding was determined by rechecking the bleeding at the end of 12 and 24 months of storage in the original pails. Results are given in Table XIX and do not indicate any pronounced common effect. For most greases there is a slight decrease at the end of 12 months after which it tends to remain steady or to increase slightly. This would tend to support the views of several investigators who believe that greases reach a point of maximum stability after an aging period. After this period they remain in a state of equilibrium.

TABLE XIX

Effect of Aging Upon Bleeding, Air Pressure Method
Bleeding in Per Cent

Grease No.	*Initial*	*12 Months*	*24 Months*
1	7.12	4.64	4.87
2	12.83	12.68	13.00
4	6.89	5.76	6.04
5	11.59	9.49	10.26
7	8.19	6.18	5.25
8	6.81	5.63	6.81
9	13.6	18.05	14.95
10	6.95	6.33	6.14
13	5.09	4.86	5.05
14	17.28	17.80	15.85
15	5.84	5.25	4.79
16	10.96	9.75	8.84
18	11.61	10.75	10.65

The effect of oil loss upon the lubricating properties of a grease has not been precisely determined. A number of field tests upon greases secured under specification MIL-G-10924 have shown them to give good performance irrespective of the extent of oil separation during static storage. In one test in particular, two greases were selected. One had shown "excessive" bleeding during static storage whereas the other had shown little or no bleeding under the same conditions. The results observed at the conclusion of the test were inconclusive. Both seemed equally effective as far as lubrication was concerned. The "bleeder" softened to a greater extent in use and seemed to give better protection against fretting corrosion. Whether this was due to the bleeding or to some other factor was not determined.

Four greases were selected for a laboratory study of the effect of oil loss on certain properties. The basis of selection was mainly the bleeding percentage and oil viscosity. The four greases selected had nearly the same oil viscosity, but varied widely in bleeding tendencies. Table XX contains the original pertinent facts concerning the greases chosen. The unworked penetration, Shell Four Ball wear, and apparent viscosity, were determined before and after bleeding. The bleeding was determined by the air pressure method under standard test conditions. The percentage of oil lost and the values of the three selected parameters before and after bleeding are shown in Table XXI. The stiffening of the grease, as represented by the decrease in penetration, and the increase in apparent viscosity at both 25 and 100 reciprocal seconds is to be expected. The apparent viscosity increase is fairly proportional to the amount of oil lost as is shown by the graph of Figure 11. The penetration change was not proportional to oil loss. The Shell Four Ball wear was not significantly changed by the loss of oil except perhaps for grease number one. These observations tend to support the field experience that loss of oil from a grease through bleeding does not materially reduce its lubricating properties, providing the oil loss is not excessive.

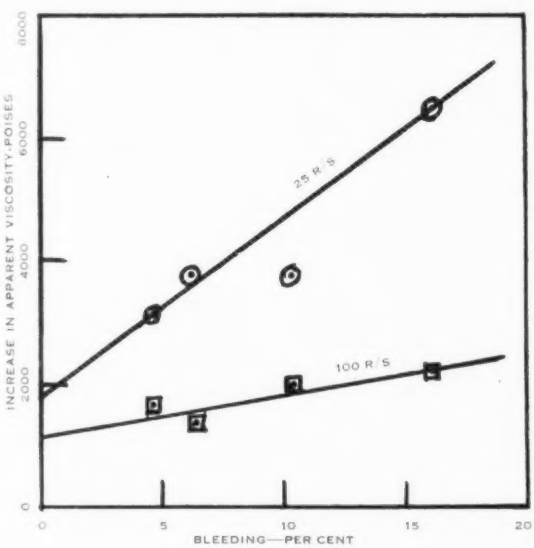


FIGURE 11. The effect of bleeding upon apparent viscosity.

Of far greater concern is the increase in apparent viscosity which accompanies this oil loss. This could render an acceptable grease unacceptable as in case of grease number one. Also a vehicle packed with an acceptable grease could become unusable in arctic conditions if oil had been lost from the grease during stor-

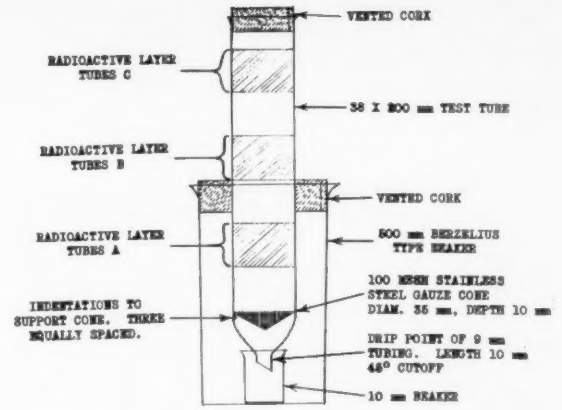


FIGURE 12. Diagram of the apparatus for a radioactive study of oil movement during the bleeding of greases.

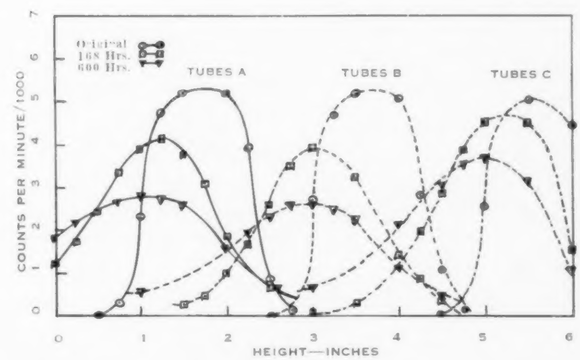


FIGURE 13. Radioactive tracing of oil movement in a grease during bleeding; original, 168 hours.

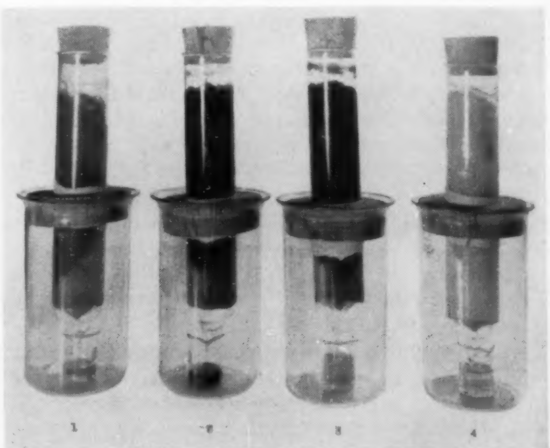


FIGURE 14. The shrinkage of a grease during bleeding.

age. This explains why the military have placed a maximum acceptable limit on the apparent viscosity and bleeding of artillery and automotive greases.

Oil Migration During Bleeding

During the investigation of possible bleeding tests the feasibility of using a vacuum to pull the oil out of a grease was tried. The results were not considered as having any promise because a dense hard layer of soap formed on the screen and stopped further oil separation. This incident resulted in some speculation as to just where the oil came from that separated from a grease which was supported on a screen. Was the oil lost from a relatively thin layer of grease close to the screen or did it come proportionately from throughout the entire mass of grease? Removing the remaining grease from the test tube, or pressure cell, in layers and determining the oil-soap ratio of each layer failed to show any significant or reproducible difference.

After some investigation it was decided to make a further study of oil migration in a grease during bleeding by means of radioactive tracer techniques. Since the test tube method utilized a column of grease approximately 6 inches high, it was selected as the most appropriate one to use. In order to secure better results, and a more accurate count, the grease was placed in an aluminum foil liner which could be removed from the test tube while making the count. It was necessary to use this liner as glass is quite opaque to the passage of radiations. The liner was made by forming 0.005 in. aluminum foil around the proper sized tube and sealing the edges together by folding and crimping. The wire gauze cone was then sealed into one end of the tube. This assembly was placed in the regular test tube bleeding cell which furnished support during the test. It could be removed readily for making the count without disturbing the grease.

Radioactive phosphorus incorporated in tricrecyl phosphate was selected as the trace element. Calculations showed that 2 milliliers of the tricrecyl phosphate in 1000 grams of grease would give an initial count of around 5000 per minute. A commercial calcium soap grease was selected for this experiment. Its bleeding rate was approximately the average of all greases tested at this time. The required amount of TCP was mixed into the grease in a common kitchen mixer and the mixture allowed to stand for two days before proceeding.

The experiment was carried out in duplicate and the averages recorded. Two aluminum cylinders designated as A-1 and A-2 were loaded as follows. A one inch layer of the non-radioactive grease was placed on the bottom of the tube next to the wire gauze. This was followed by a 1 inch layer of radioactive grease after which the tube was filled to the 6 inch mark with the untreated grease. This result was a layer of radioactive grease near the bottom with non-radioactive grease above and below it. In the same manner tubes B were loaded with the radioactive layer between the 3 and 4 inch heights and tubes C with the radioactive grease between the 5 and 6 inch marks. In this way the oil migration at the bottom, at the center, and on

TABLE XX

Characteristics of Greases Selected for Oil Loss Study

Grease No.	*Unworked Penetration*	*Soap Per Cent*	*Soap Type*	*Oil Vis. SUS @ 100 F*
1	318	12	Li-Ca	77
2	285	10.4	Ca	76
3	290	13	Ca	72
4	290	12.4	Ca	75

TABLE XXI

Changes Occurring in a Grease After Loss of Oil

Grease No.	*Oil Loss Per Cent*	*Unworked Penetration A**	*Unworked Penetration B**	*Shell 4 Ball Scar Diam. A*	*Shell 4 Ball Scar Diam. B*	*Apparent Viscosity 25 R/S A B*	*Apparent Viscosity 100 R/S A B*
1	16.17	318	248	.345	.383	16500-23000	8500-10700
2	10.3	285	257	.278	.278	18000-21800	9600-11600
3	6.34	290	248	.377	.368	20200-24000	9200-10600
4	4.69	290	270	.293	.296	11000-14100	6550-8200

*A—Original *B—After oil loss

the top layer of grease could be studied. Figure 12 shows graphically the method of loading the various tubes.

In determining the radioactivity the Geiger counter was covered with a lead sheet with a narrow slit 2 MM wide by 8 MM long cut in it. This limited the radiations entering the counter to a small uniform area for all cases. Counts were made at ¼ in. intervals and extended far enough on each side of the radioactive area to pick up any increase or decrease in activity. A summary of the results is found in Table XXII. The values are given in counts per minute and are for the tubes held at 160 F. The table contains only enough data to show the trend. Values at other heights and times were obtained but are not shown as these merely corroborate the data given. Graphs of the values in Table XXII are shown in Figure 13 to further emphasize the trend.

TABLE XXII

Results of Radioactive Count—Average Values 160° F

Height Inches	*Original*	*48 Hrs.*	*168 Hrs.*	*336 Hrs.*	*600 Hrs.*
		TUBES A			
0	0	0	1182	1586	1640
¼	0	436	1683	2366	2150
½	18	1230	2311	2727	2548
¾	236	2839	3280	3126	2584
1	2284	4294	3862	3335	2750
1½	5176	5000	3668	3077	2533
2	5181	3173	1870	1902	1591
2½	819	598	604	803	781
3	0	0	69	278	420
		TUBES B			
1	0	0	0	0	495
1½	0	0	193	596	802
2	0	98	924	1622	1600
2½	16	938	2521	2770	2300
2¾	127	2535	3482	....	2550
3	2768	4228	3928	3316	2522
3½	5160	4808	3264	2686	2218
4	5027	2797	1362	1380	1144
4½	1100	433	325	541	570
		TUBES C			
3	0	0	42	401	618
3½	0	0	228	1032	....
4	0	51	1132	1987	2075
4½	25	866	2878	3263	3030
4¾	206	2448	3818	3976	3580
5	2550	3980	4506	4681	4200
5½	4938	5003	4440	4344	3624
6	4482	4050	1556	1386	1010

It is apparent from the data presented that oil lost from the bottom of a grease container through a screen or small openings is replaced by oil from above. The tendency seems to be to maintain approximately the same oil content throughout the entire grease mass. These observations are for the case of gravity separation only. It is conceivable that application of pressure could force the oil out of the layer next to the screen faster than it could be replaced from above. It was also noted that the top of the grease column lowered as much as ¾ inch during the course of the experiment. This lowering roughly corresponded to the volume of oil lost and is explainable on that basis. The surface of the grease was also dry in appearance and slightly cracked. This condition might be due to the evaporation of some of the oil during the long exposure to the relatively high temperature. This shrinkage is shown in Figure 14 which shows four greases held under the same temperature conditions for the same period of time. The aluminum sleeve was omitted in this case so that the grease surface could be seen.

As further evidence of this over-all oil migration the data in Table XXIII is presented. The data includes: (1) grams of oil lost from test tubes A, (2) Lowering of high count point in inches tubes B, (3) Lowering of 500 count point in inches, tubes B and (4) Increase in oil count in counts per minute per milligram of oil taken on tubes A. It was necessary to use tubes A and B, because during the time of the test no radioactive oil was lost out of tubes B or C. Also the 500 count level had fallen below the grease level in Tube A making it necessary to use the data for tube B for this factor. Actually the data for all three tubes was remarkedly similar with the exception noted.

TABLE XXIII

Data on Radioactive Tracer Study of Oil Migration During Bleeding

	Time – Hours 24	48	72	168	336	600
Oil Loss, Tubes A, gms	3.5	5.8	7.8	14.4	17.9	20
Lowering High Count Point, in.	0.20	0.25	0.35	0.65	0.75	0.85
Lowering 500 Count Point, in.	0.30	0.53	0.68	1.10	1.50	1.80
Oil Count/Min./Mg.	4.26	7.07	6.13	10.63	14.60	16.10

This data is shown graphically in Figure 15 and shows in a striking manner the correlation of the four items. Similar data taken from the tubes held at 100 F show a like correlation, but the actual values are lower. It is apparent that under the conditions of the test any loss of oil through a screen is compensated for by oil

migrating from portions of the grease not in contact with the screen. This migration tends to keep the oil-soap ratio uniform in all portions of a grease. It should be emphasized that this condition holds where the oil loss is slow and is not forced by unusual suction or pressure. In the latter case the oil loss from the portion

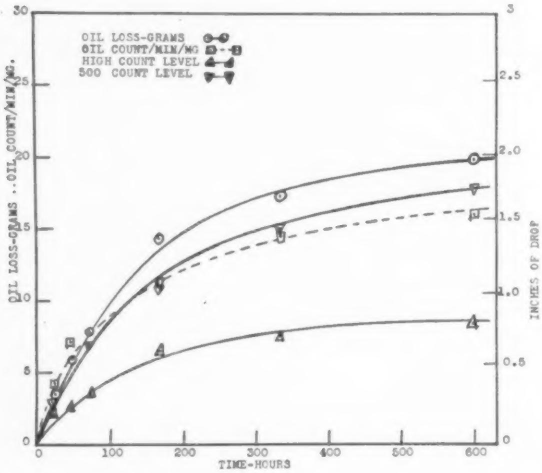


FIGURE 15. Observations during radioactive tracer studies.

of grease in contact with the membrane might be more rapid than could be replaced by oil migration. This could result in the dense soap layer next to the screen mentioned above.

Theoretically this loss of oil could go on until only the filler was left with a mono-molecular layer of oil adhering to it. Wright Air Development center[24] has studied the oss of oil from a grease under centrifugal force. Forces of 25000 G's resulted in loss of only 75-80 per cent of the oil in a grease. The remainder of the oil could be accounted for by this mono-molecular layer on the surface. No records are available on the amount of oil that can be lost from a grease by gravity forces alone. It is no doubt much less than mentioned above and would be exceedingly slow toward the end.

Further studies planned for this Arsenal are directed at obtaining additional and fundamental knowledge of the relationship of grease bleeding to structure and other parameters.

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About the Author

S. F. Calhoun *received a B.S. and M.S. in chemistry from Iowa Wesleyan and Iowa university. While in college he served as research assistant and did work on chlorination of fatty acids and ethanol-tetachloride system. In 1952 he joined the research staff of Rock Island arsenal and has worked on synthetic lubricants, oil separation and anti-oxidants. He is also a member of the American Chemical society.*

Discussion of "The Ordnance Corps Looks Into Grease Bleeding"

By R. H. Leet and A. C. Borg
Standard Oil Co. (Indiana)

MR. CALHOUN HAS DONE a good job of illustrating many of the variables involved in grease leakage. Because of the complexity of the problem, the variables need classification. They could be classified as chemical, structural, and environmental as shown in the list in Table I. Tests have been designed that measure leakage caused by changing one or more of these variables.

The chemical and structural variables are subject to some control by the grease manufacturer. For a specific or multipurpose application, he can design properties into the grease to keep undesired leakage at a minimum. The grease consumer can check for leakage resistance by one or more of the tests that impose specific environmental conditions. This combination appears to solve all the problems. But it doesn't.

TABLE I

Variables Involved in Grease Leakage

Chemical	Structural	Environmental
Thickener-surface polarity	Thickener concentration	Temperature
	Thickener size	Pressure
Oil polarity	Thickener shape	Gravitational force
Additives	Thickener dispersion	Capillary forces
	Oil viscosity	
	Oil viscosity index	

In service, a grease is often subjected to many environmental conditions that may cause leakage. If the consumer has not chosen his specification tests to realistically evaluate leakage in his application, even greases that have passed all of them can exhibit excessive leakage.

A good example of the complexity of environmental factors arose in this paper. Mr. Calhoun found that greases lost oil at a higher rate in the pressure test with the 200-mesh screen than with the 100-mesh screen. The difference could not be explained by the difference of size of holes in the screen. The explanation might lie in the type of screen used. Most screens used in these tests are made of woven wire; where the wires cross, they form a small space of capillary dimensions. The size of this space should be inversely proportional to the amount of leakage. Consequently if the two screens contained wire of different gauge or were woven by different techniques, the size of the capillary space could depend more on these variables than on mesh size.

The relationship between thickener particle shape and leakage deserves comment. The greases used in this study were peculiar in that they contained particles of different length-to-width ratio but had the same consistency, thickener type and concentration, and oil type. Because particle widths and concentrations were constant, the L/W ratio measured the number of particles per unit volume. The larger the ratio, therefore, the fewer the particles per unit volume. The relationship shown then is probably only the relationship between leakage and particle concentration.

Mr. Calhoun should be specially commended for studying oil migration during bleeding. His radioactive-tracer test appears to prove the contention that oil migrates throughout the grease when it is subjected to pressure-leakage tests.

Further work must be done on the leakage problem. Particularly needed are information on acceptable amounts of leakage in service and better definition of the environmental factors in various grease applications. ■

NLGI Technical Committee Column

Chairman
T. G. Roehner
Manager,
Technical Service Laboratory
Socony Mobil Oil Co., Inc.

It has been decided that the new Technical Committee on Fundamental Research will hold its meeting during the second day of the NLGI Annual Meeting in October, in Chicago. A half-day has been assigned paralleling the main session. Dr. J. J. Kolfenbach, chairman of the Technical Committee on Fundamental Research, already has sufficient offers to more than account for a half-day. Consideration is being given to the possibility that for the subject meeting the papers may be limited to those dealing with rheological properties.

At the 1957 Annual Meeting, it was agreed that the Technical Committee would recommend to the Board that a new committee be established to complete the write-up of "Recommended Practices for Lubricating Ball Joint Type Front Suspensions." President Cubicciotti will set up that committee in the near future and its membership will include personnel qualified to do a professional write-up job.

The replies to the questionnaire distributed to all members of the Technical Committee regarding the advisability of reorganizing some or all of the present technical committees continue to show a wide variation of opinion. All of the replies will be given careful consideration by the Steering Committee. ■

Presented at the NLGI 25th annual meeting in Chicago, October, 1957

"selling the magic film promotionally"

H. A. MAYOR, JR.—Southwest Grease and Oil Co.
JACK HODGES—Southwest Grease and Oil Co.
OLIVER ELLIOTT—National Sales, Inc.

GREASE, THE "MAGIC FILM," the product of our industry, like everything else in today's pulsating economy, must be sold! In our plant, as in your plant, until there is a firm order booked, complete as to product, package and delivery conditions, there is nothing that could be classified as really exciting. Everyone should agree that orders resulting from energetic, enthusiastic, product promotional efforts are the salvation of our industry. In this article, an attempt will be made to present for you our interpretations of the type of energetic, enthusiastic product promotional efforts we feel can be expected to increase our industry's sales. We will do so, realizing, as the old saying goes, that the largest room in the world is the room for improvement. There are, no doubt, better grease selling techniques in use today—we know that later we must develop better ones. Industry-wise we must improve our sales efforts if we are to meet the long range challenges which are so clearly before us.

For our purposes now, let's assume that arrangements for the following eight hour workshop were completed after persistent, persuasive discussions with the subject company's top level executives. During these discussions it was effectively pointed out—

1. Grease sales ratios should, and possibly could be improved.
2. The increased sale of grease, a prestige type petroleum product, could improve overall product sale.
3. Their grease supplier stood ready and capable of teaching their field men about grease, the magic film. Further, they were anxious to actively participate in their basic training program.

Further, for our purposes, and only to simplify and lend credence to our efforts, our presentation will involve four territory representatives of the Derby Oil company, which in true life is an aggressive, relatively small, fully integrated, midwestern petroleum marketer. In reality, Derby could well be any petroleum marketer, as an independent distributor, or as a jobber of major oil company products. Of importance only is their natural desire to sell more grease at greater profits, a desire that should be shared by other petroleum marketers around the world. What will be done today for Derby could be done tomorrow for any petroleum marketer.

With these assumptions, the stage has been set. The opportunity for which we had been hoping had been created. Here was a chance to broaden our all important sales foundations, a chance to communicate face-to-face with our front line contact men. It's the type of opportunity for which our industry should always strive.

When we are blessed with such an opportunity, let's not leave a stone unturned in our efforts to impart to the men involved, the knowledge and confidence they will need to sell grease, the magic film, the product of our industry, promotionally.

Curtain Opens on Scene I

PLACE—Kettle room of a grease plant

CHARACTERS—Grease Salesman .... Jack Hodges
Grease Maker .... Bert Melchar
Four Derby Salesmen

Derby Salesman: Do you actually mean that before

you have grease, you have soap? Is it the kind my kids don't like?

Grease Salesman: (Jack reaching onto shelf adjacent to kettle and getting a small piece of soap and mixing with water to make suds in his hands—) Yes, the true manufacturing operation in a grease plant is soap making—an operation entirely different from anything else in the petroleum industry. It's true that grease contains large portions of petroleum lubricating oils and that grease is predominately marketed by petroleum marketers, but basically, grease making is an industry of its own. It's an interesting and challenging industry and we are proud to be a part of it.

Here is the soap that was made last night in this kettle. Now it's like a sponge that's soaking up the oil you see entering this kettle. Together, the soap and oil will make grease.

Derby Salesman: (Handling the soap) It smells like soap. It even cleans like soap. I guess grease isn't the dirty, nasty product I've always thought it to be. How long has this batch been cooking?

"IT'S said that grease making is an art—not a science."

Greasemaker: This batch was started just after midnight. Manufacturing is completed in a six to eight hour cycle and the finished, laboratory approved, product is ready for packaging early the next day. There are many types of greases though and naturally, cooking time varies. There are also many product variables, such as raw materials, temperatures, product consistency, cooking pressures. They all contribute to individual batch cooking time requirements.

Derby Salesman: When do you know this batch is done?

Grease Salesman: That's a good question. It's often said that grease making is an art—not a science. Someway somehow, the trained greasemaker knows. He works from a carefully developed formula and manufacturing procedure for each product. There are many control tests to guide him in his work. He's the doctor, and it goes to the laboratory for final checking when he says it's finished.

Curtain Closes

So went the first two and a half hours the Derby men spent in our plant. They lingered long in the manufacturing and filling departments, familiarizing themselves with the procedures involved. Nobody is denying that the approach is basic, but have you ever stopped to realize how many men are now being asked to sell grease who have never been in a grease plant? We have worked with many men who have said that nothing instills in them as much confidence and desire to sell grease, the magic film, as does the actual witnessing of the basic procedures and techniques involved in its manufacture. These same men also testify that the shop talk that invariably passes between manufacuring and sales people during plant visitations, cannot help but enlighten both. It's generally agreed that the sales and manufacturing segments of our industry both benefit when they are brought face to face. After such visits, their professional objectives cannot help but be more closely and intimately interwoven. Again, let's be sure that the men we ask to sell the products of our industry have seen and are familiar with our plant operations.

Our day long workshop continues. After their plant tour, our aspiring grease salesmen were escorted to the laboratory, where they were given a complete description and resumé of the basic laboratory control and research tests that are available to the grease maker and research chemist. They actually witnessed the tests with which our industry works. The NLGI term, "310-340 Penetration" became significant to them. No longer did the reference to a "CRC Wheel Bearing Test" cause wrinkles of doubt to appear on their faces.

Little did these men realize how closely individual greases were controlled and to what extent they were tested. During this same laboratory visit they also were shown, and actually participated in, some simple, easy to understand demonstrations related to the multipurpose characteristics of the newer type greases.

Curtain Opens on Scene II

PLACE—Grease Plant Laboratory

CHARACTERS—Grease Salesman ....Jack Hodges

Four Derby Salesmen

Grease Salesman: This demonstration is designed to show the multi-purpose characteristics of Derby multi-lube lithium grease. For a number of years, soda soap greases were considered to be the standard for lubrication of wheel bearings, universal joints and other high temperature applications. At the same time, calcium soap greases have been the standard for lubrication of water pumps, chassis and other wet applications.

Now we have a grease to do the job of both soda and calcium—and more too! There are presently other types of multi-purpose greases, but we feel Derby multi-lube lithium is the most versatile and one of the most successful of these types.

In this demonstration we will use good quality soda soap and calcium soap greases. We will compare these older products with Derby multi-lube lithium grease under conditions similar to those encountered in actual greasing conditions.

This demonstration is based on four test conditions. First, a heat test with which we will be able to visually observe the melting characteristics and get some idea of the melting temperatures of these three products. Second, a test to compare the water resistance and water stability characteristics of the test lubricants. Third, we will compare the mechanical stability of the grease, or the resistance of the grease to break down or thinning after actual working. Fourth a test to compare the low temperature performance of the test lubricants.

To perform the mechanical stability part of the demonstration, we have three unworked samples of these greases and three grease workers filled with the demonstration greases. The workers are composed of a cylinder sealed at both ends with movable plate inside. This plate has a number of small holes drilled through it. When the grease worker is pumped backward and forward, the grease is forced through these small holes giving it much the same action as it is subjected to in wheel bearings, or any other type of bearing. After the grease has been worked, we will remove the worked samples, then place them in containers and observe the penetration of steel balls dropped from a given height into the worked samples, as compared with the same size balls dropped into the unworked samples.

In the portion of the demonstration covering the low temperature pumpability of the three greases, we will compare the ease of pumpability at room temperature and then by placing ice and salt in the tank, we will be able to observe the relative difficulty of pumping the various greases at lower temperatures.

It takes some time to bring the temperature down on the low temperature pumpability portion of this demonstration, so in order to move the program along quickly, we will start with this: First of all, I would like for one of you to come up and pump each one of these guns one or two strokes, and then tell the group how the guns pump in relation to the ease or difficulty of pumping the greases at room temperature. (One man is selected from the group to come up and pump the guns and gives an oral report to the rest of the group covering his experience.)

We now have seen that at room temperature these greases all pump about the same. There may be slight variations between the different products, but essentially, they are all very easy to pump. I will now ask my assistant to ice up the tank so it can start cooling down and we will go over to the high temperature portion of the demonstration.

In this cabinet we have three 250 watt infra-red heat lamps suspended so that the rays are directed down on the stainless steel plate. Under each of the bulbs, we have placed a screen with a sample of the individual greases. A short time ago this unit was plugged in, and we can now observe what happens to those greases under high temperature conditions. Keep

"BY actual participation the group became interested."

in mind we are not making a scientific type demonstration in that we have no way of knowing exactly what the temperatures are under these lights at any one time. We are primarily interested in determining the relative heat that it takes to melt the products, and also in observing how each grease reacts once it has melted. We are actually interested in the temperature at which only one of these products melts, and in this case it is the calcium grease, which will begin to melt at approximately 180°F. We need to know this information only as it will pertain to another part of this demonstration. The longer the bulbs are lit, the higher the temperature on the samples will become. The first one to melt will naturally have the lowest melting point. The second, the next higher, and the third, of course, will have the highest melting point of the samples used.

See, the calcium grease is beginning to melt, a stream of oil is starting to separate from the soap and is flowing out from under the screen and down over the tray. Obviously, this product melts at the lowest temperature, and as I have previously stated, it is approximately 180°F. You will also note that the products flowing from the screen are almost entirely lubricating oil. The body of the oil is causing it to carry some small particles of the soap along with it. This grease sample has been completely destroyed through heat, so it should be very obvious that a calcium type grease should not be used in any application where temperature conditions are very high.

You will note at this time that both the Derby multi lube lithium grease and the good quality soda soap

grease are still very firm and at this stage of the test are standing the temperature very well.

As the temperature continues to rise, we will equal and surpass the melting point of both of these greases. At this point it is important that we observe not only the time required to melt these products and the relative melting order, but also the characteristics of the melted product.

From my position, looking down on the samples, I note at this time there is some melting in the soda soap grease. Because this product has a heavy viscous oil, the flow of the oil as it separates from the soap, is much slower than in the case of the calcium soap grease. As the oil runs away from the screen and across the exposed part of the tray, you will note that it is also carrying along some soap particles, even more soap is being carried along than in the case of the calcium grease. Here, again, the soda soap is being destroyed. The soap and oil are separating because of the high temperature, and it would be impossible to recombine them again into soda soap grease.

You will also note that the Derby multi-lube lithium grease has begun to melt but notice that the melting characteristics of this product are completely different from the other two. Derby multi-lube lithium has the characteristic which we call reversability. This means that as the product goes from a solid into a melted condition, because of increase in temperature, the soap and the oil are not separated and the grease is not destroyed. The soap and oil flow together much as the wax of a candle flows. As soon as the grease has reached a point on this tray below its melting point, it regains its original consistency.

Time will not permit the presentation of the complete 50 minute demonstration. In manners and methods which you have just reviewed, Jack effectively demonstrated and described the water resistance, mechanical stability, and low temperature pumpability characteristics normally found in a good multi-purpose grease.

By actual participation in the demonstration, the group became especially interested in the mechanical stability and low temperature demonstrations. (Jack here passes grease workers around and has a Derby salesman come forward to pump the guns.) By their own expressions, it was plainly evident that they now understood the "whys" and "wherefores" of a multi-purpose grease. It was plain to them that such a multi-purpose grease should become the backbone of their lubricating grease line. After witnessing and participating in this demonstration, they were enthusiastically awaiting their chance to utilize this newly acquired knowledge in a face-to-face sales situation.

We would like to claim credit for the original development of these demonstrations, but, it seems the better part of valor to admit that similar techniques and methods have been successfully used by other grease marketers. Our modified use and adaption of the overall presentation to our situation today is but a vote of confidence for the original ideas. This type of demonstration has made and can continue to make a significant contribution to the sales efforts of our industry.

To indelibly inscribe the test results and conclusions into the memories of our participants, liberal quantities of a colorful folder, that included (1) pictures and description of the demonstration, (2) attractively packaged small product samples, (3) complete specifications and (4) recommended uses were distributed. They were told how such folders could be successfully used in their daily sales efforts.

Curtain Closes

During the luncheon that followed, Grease the magic film, continued as the main topic of discussion. It was plainly evident that everyone agreed that, as has been previously proclaimed from the same rostrum—

1. A man will sell only that with which he is familiar.
2. The easiest approach to a signed order is through the consumers eyes. If you literally lubricate his eyeballs, you'll soon be lubricating his equipment.
3. Effective demonstrations can be built around a product's appearance, consistency, color and performance.

Let's refer to the next portion of our session as an effort to "pave the way" for the free and unrestricted flow of our industry's products to their final end, their use by a satisfied consumer.

At this point, during just such a session as we are trying to depict today, one of our visitors asked the following question—what is the final, ultimate fate of grease? Where does it go when it is worn out? What physical or chemical change occurs during its use? You should have heard the stuttering and stammering that followed, and we still haven't come up with the answer.

In our way of thinking, this product flow must involve two major components. First, containers to carry the product from our cooking kettles to the approximate point of use and, second, after its arrival at this point, dispensing equipment to effectively place the magic film "on the job." Who could do a better job of helping the Derby people "pave the way" than Oliver Elliott of National Sales, Inc., a company specializing in the sales of promotional lubricating equipment and containers. Because of many past successful experiences based on similar cooperation with our industry's suppliers, Mr. Elliott's assistance has been requested.

Curtain Opens on Scene III

PLACE—Sales Room of Grease Manufacturing Company

CHARACTERS—Container and Equipment Salesman .... Oliver Elliott

Four Derby Salesmen

Salesman: We sincerely believe that the package often sells the product, and therefore, prudent judgment must be exercised when selecting lubricating grease containers. In our opinion, one of the best aids for promoting the sale of Derby lubricants will come from well-designed, properly-selected packages. For today—we are only going to show the small and medium sized containers, but plain or lithographed drums may be obtained in all sizes. Obviously, a firm would not use all of these containers in a marketing program, but we want you to see the fine selection which is available.

We want to stress emphatically that appealing designs in attractive colors can do a profitable job of merchandising. The lithographed message on a container is undoubtedly the least expensive advertising available to any oil company. Competent container salesmen, co-ordinating their efforts with your advertising and sale departments, can create lithographed packages which will generate real product interest. When only attractive plain coated or galvanized containers can be used, excellent product and company identification can be secured by silk screening, stencilling, decals, or labels.

Let us start with the smallest package in the grease container line—it is one of the most recent and certainly one of the most popular. I am referring to the 14½ ounce grease tube, which can be loaded in many of the lever guns now being sold. It comes ten units to a carrying carton, and five or six carrying cartons to a master carton. The grease tube is the latest innovation in grease packages, and since newness is a most important sales promotion factor, it deserves considerable consideration.

Next, we have the various small cans which are used for packaging grease. The multiple-friction can is available in one and five pound sizes and is so named because it is designed with a multiple seal at the cover opening. The full friction can, which has a plug-type closure, is made in one, five and ten pound sizes. All of these containers have the advantage of offering long shelf life and maximum useable advertising space by lithography. This class of container has a definite sales appeal for shelf-selling outlets catering to the "do-it-yourself" trade.

The next containers are known as flaring pails. First in the ten pound flaring pail, which has a liquid ca-

pacity of slightly more than five quarts. These pails can be furnished in black plate or galvanized steel—coated or lithographed. Flaring pails are potentially excellent promotional containers—especially if made of galvanized steel, because of their many possibilities for reuse. A slightly larger flaring pail, which holds 25 pounds of grease, has been well-received, primarily by the farmer, since he finds many extra uses for it. Because of their exceptional utility at a low cost, flaring pails are a valuable asset in many lubricant sales campaigns.

It is interesting to note that after these two sizes of flaring pails proved so popular, there were many unusual packages designed for grease containers—aimed to be still more desirable to the retail customer. Galvanized chicken watering fountains, drain pans, and funnels were some of many utility containers made for the additional purpose of packaging greases. Their per pound package costs increased to the extent, however, that most of these containers have been discontinued.

There is one outstanding exception to this statement. The galvanized half-bushel container has proved an attractive package for marketing farm greases for a great many years. The most common half-bushel is made of 30 gauge galvanized steel, and is generally filled to hold 30 pounds of grease. Since a similar empty galvanized bucket costs from $2.00 to $3.00 at a farm supply store, it is easy to understand why the rural customer likes this package. At an additional cost, the half-bushel basket can be furnished in a still slightly different design with a hot dip galvanized finish and a seamless drawn bottom. The galvanized half-bushel will definitely help sell farm greases, and it can be the satellite to carry a farm promotion program with continuous and great impact.

Our next package is commonly called the five gallon kerosene type container, though it is also known as the tractor fill can, kero can, or five gallon utility can. Because of its relatively small opening in the dome top, only the more fluid weights of lubricating grease can be filled in the kero can. It is most generally used for packaging motor oils and gear lubricants. In this field, it is virtually unchallenged as a popular promotional container with automotive, industrial, and farm customers. The utility demands for the kero can are many and varied, and this assures the Derby marketer of his product being more readily accepted.

Another specialty container is the E-Z-Fill pail, available in 25 and 35 pound sizes. The E-Z-Fill is a grease gun loader pail, which is designed for filling lever guns directly from the side of the container. The cover of this pail is never removed, therefore, many problems of grease contamination are eliminated.

We now come to the pail most commonly used in the grease industry. We are, of course, referring to the lug cover pail, which can also be furnished with a solid top and is then known as a closed head drum. The lug cover pail or closed head drum is usually available in sizes from three gallons up to and including six and one-half gallons. The three and one-half gallon lug cover pail will hold 25 pounds of lubricant, and it has been widely accepted. The five gallon lug cover pail, which holds from 35 to 40 pounds of grease, is probably used by every oil marketing company in the United States. By this over-whelming acceptance, it is obviously a dependable and durable container, though this general use may eliminate its value as a sales promotion item.

There is a wide variety of nozzles and pouring equipment accessories which can be inserted on the closed head or the lug cover of this package. One of the most interesting modifications of the lug cover pail is the insertion of a 73 mm. U-Pressit nozzle and cap in the center of the cover. A Fil-Rite follower plate can then be furnished with this container, resulting in an efficient gun filling pail.

It is rather difficult to give more than a capsule idea of the many sales promotion advantages offered by proper selection of your grease containers. Please keep in mind, however, that many times the package will control the recaptivity of your product through eye appeal, utility value, reasonable cost, and sturdy construction. Thus, in many instances, your customer will buy the product on the basis of what he sees *on* the container—not in it.

Curtain Closes

The Derby salesmen at this point were naturally in doubt as to just what containers to include in their revitalized grease sales program. They quickly realized that there were many possibilities for package promotional schemes.

During meetings and discussions that followed Mr. Elliott's broad presentation, a simplified, yet practical line of containers was chosen. These containers quickly became an integral part of Derby's magic film selling program. But what about that other important component of a good marketing program, dispensing equipment?

Curtain Opens on Part II of Scene III

Salesman: For this presentation, we will show several different types of hand operated lubricating equipment, which can be used to promote the sale of grease. Each of these guns is merely representative of equipment which can be successfully used, and it is obvious that there are many other brands which might be displayed here. After a description of each unit, followed by demonstrations, we shall discuss the possibility of Derby using some of this equipment. It is not recommended that you consider more than two of these units for now, but eventually, all of these products could be used advantageously for spring and fall grease promotions.

"PROMOTIONAL lubricating equipment must sell greases."

Promotional lubricating equipment can be very effective in introducing a new line of lubricating grease, but it can also prove helpful to companies already marketing lubricants. Every sales program needs a regular injection of enthusiasm, and many times this can best be accomplished with a new or different grease gun.

We must also stress that the finest grease is of no value until it is doing an effective job of lubrication. This means that an alert oil company salesman must be well informed as to the best available lubricating equipment. Such a salesman will anticipate many of his customer's needs, and he will also recognize the limitations or advantages of certain equipment. Too often we gloss over the necessity for compatibility between lubricating grease and grease gun, and on many occasions these facts are learned too late—after a customer has been lost. With our fast moving and continuously changing markets, it is imperative that a good grease salesman have a basic knowledge of both lubricants and dispensing equipment, so he can successfully recommend the proper combination to do a specific job.

The important and primary function of promotional lubricating equipment is that it must sell grease. Many other sales advantages should be offered, but promotional units must always accomplish their prime objective. Usually this requires the combination sale of grease and equipment.

The lever gun is the "heart" of promotional lubricating equipment, and it is the item most commonly used for this purpose. Prior to our modern lever guns, the early hand grease guns were very similar to this Alemite Model C-600, which is used with a pin-type grease fitting. At a later date, a push-type gun was introduced. These two units, manufactured by the Alemite division of Stewart-Warner corporation of Chicago, merely show the evolution of development to our present-day lever gun. We now see a late model Alemite grease gun, which can be effectively sold

with pails or drums of Derby multi-lube lithium. It also is an excellent promotional gun when used in combination with certain loader type pails or pumps.

From this series of guns has come the latest development—a tube loading grease gun. We are now showing the three-way Load-A-Matic lever gun, which is made by the Superior Manufacturing company of Albert City, Iowa. It can be filled either by hand, by filler pump, or by grease tube. With the added feature of being a tube-loaded gun, it obviously should be used in introducing a grease tube program. Many marketers combine 10, 25, 50, or 60 tubes with a gun in special promotions. We would suggest your using the 50 tube master carton and gun as a similar introductory offer at a profitable price. Through such sales efforts, millions of tubes and thousands of guns have been purchased. The reorder of this package has exceeded all expectations during the past year. Many companies believe the grease tube and gun will eventually replace the present small grease cans that have been in the industry for many years. When the salesman has the tube and gun in his hands for demonstration, a field survey has proved this combination will sell 90 per cent of the time to the consumer trade. In a presentation by sales circular, without the tube and gun, sales drop to 30 per cent. This statement should prove equally true with other equipment shown here, because intelligent and enthusiastic demonstrations are the power behind the promotional punch.

From a multitude of different lever guns, the promotional lubricating equipment field meanders in several directions. The popularity of lever guns, together with customer demand for improved methods of lubrication, caused the creation of an entirely different grease gun. A unit typical of this type of equipment is the Speedy Greaser Model PE-4A made by Balcrank, Incorporated, of Cincinnati, Ohio. It offers the convenience of being operated by one man with one hand at pressures up to 8,500 pounds p.s.i. through the booster assembly. The Speedy Greaser fits on any standard lug cover pail; it has a telescoping pump tube which allows one gun to accommodate all standard pails. It is always desirable for promotional lubricating equipment to fit on a refiner's container, since this assists in lowering its cost, plus keeping the container advertising constantly before the public. Guns of this type are regularly combined with the sale of from three to five pails of grease with consistent success. Many oil companies have used this gun to introduce a new line of lubricants, with the result that some have sold in excess of 10,000 guns per season. This fact means little until we understand that each gun was sold with

at least 105 pounds of grease. Thus, such programs have reaped more than 1,000,000 pounds of extra grease business. These figures are vivid proof of the potential, available through sound promotional merchandising. This example is not a single nor isolated one, but to our knowledge, has been accomplished by several major and independent oil companies.

The next item in our display is the lever gun filler pump. This particular model is known as the "buck shot" grease gun, and it is made by Gray Company, Incorporated, of Minneapolis, Minnesota. The "buck shot" model, in addition to being a good filler pump, has the added accessories of a five-foot hose assembly with a quick-detach booster valve. This makes the Graco unit a combination filler pump and high pressure *or* volume grease gun. A filler pump, when sold with several pails of grease, makes an excellent combination package. Since it is relatively inexpensive, the filler pump is a fine promotional item because the combined price for grease and pump can be kept very low. Literally millions of these gun fillers have been sold as promotional premiums. A similar filler pump can also be furnished to fit on 100 and 120 pound grease drums.

We have now covered most of the generally recognized promotional equipment. Since new items are always of interest, it behooves both equipment and lubricant manufacturers to be ever on the lookout for unusual grease guns which will create additional grease sales. Two examples of the more "futuristic" styled guns are next on our list. First, we have the Aro-Pak Lubricator, manufactured by Aro Equipment corporation of Bryan, Ohio. This unit is lightweight, holds five pounds of grease, and features a permanent air-prime in the reservoir tank. The Aro-Pak offers one-hand operation with volume delivery, and it has great portability in that it can be carried by a rifle-type shoulder sling. The unit is loaded by a filler pump as shown here.

Another gun in our "look-to-the-future" classification is the Jet-Zer-Ator sold by National Sales, Incorporated, of Wichita, Kansas. This unit features a hydrajet pump, which develops its pump power from a sealed unit of compressed air. The Jet-Zer-Ator, however, does not require air nor electrical connections, and is therefore readily portable. It has a self-adjusting pump for use on all standard 25 to 40 pound pails, and also has a continuous flow booster valve which is capable of developing pressure in excess of 7,000 pounds p.s.i. With a vacuum-developing follow plate, this gun will handle all of the multi-purpose greases—even in extremely cold weather. The Jet-Zer-Ator has been a highly successful promotion item when combined with lithium grease in introductory sales programs.

We have tried to give you a brief résumé of equipment available for sales promotion purposes. We know proper application will sell lubricating greases, and because of this fact, we confidently recommend this promotional equipment to Derby. You are welcome to ask any questions regarding these grease guns, and following the question and answer period, we shall demonstrate each gun so you will thoroughly understand how it operates.

We certainly believe neither equipment nor grease can be sold from a circular—the sweet scent of a sale comes only by *demonstration.* As we are prepared to do here, so by demonstration, you must be prepared to offer your customer visual proof of your knowledge and ability. For the grease salesman who thinks he can sell by the printed word alone, we submit the following verse: "They laughed and said it couldn't be done, but he smiled and went right to it, he tackled the job that couldn't be done—and by golly he couldn't do it!" This is our point—a sale cannot be made by simply showing a circular—get the order by demonstration!

Curtain Closes on Scene III

So went the major portion of the afternoon session. The balance of our time was spent answering the questions and discussing the many possible sales program variations that were in the minds of our alert visitors. Before departing, in demonstration of our firm belief that a successful salesman always carries something to develop curiosity, our Derby men were given a liberal sample of visi-bag samples, each containing a small grease-proof card with the Derby Star and product name upon it.

In a short, hard-hitting summary of the day's activities, they were reminded that their business of selling, and our business, too, thrives, revives and survives on ideas—that the grease manufacturing industry was a versatile, fast moving one. It was an industry that would and could quickly and completely investigate any logical ideas or suggestions that individually or corporately they may have about our products, packages and equipment.

Before leaving, they realized that our industry knew that our job was only half done when our sales to a jobber or distributor were finalized. Until the magic film is placed in the hands of the consumer, and used, they knew we were in the boat with them.

Had our promotional efforts been successful? Had we armed these men with the desire, the knowledge, the tools, and the ability to sell the magic film promotionally? We know that knowledge becomes selling power only when it is put into action.

Curtain Opens on Scene IV

Place: Western Kansas Farm
Characters: Derby Salesman .... Jack Hodges
Farmer .... Walt Pannell

Derby Salesman: Good morning, Mr. Pennell. I'm Jack Hodges with Derby Refining Company. We're sure having ourselves a winter aren't we?

Farmer: We sure are. What are you doing out on a day like this?

Derby Salesman: I thought this might be a good time to talk to you about our products. I'm sure you're familiar with our gasolines and motor oils, but you may not know that we now have a full line of lubricating greases designed to do a superior job of lubricating your equipment.

Farmer: Well, I've been using a fibre grease for a long time and I'm getting along all right with it. I haven't had any trouble, and don't believe I want to change now.

Derby Salesman: I see! I'm finding some of the farmers in this area are having some trouble pumping grease this winter. I have a Jet-Zer-Ator filled with one of our new greases. This is a real fine piece of equipment. It gives one hand operation with plenty of pressure to break frozen fittings. It also has a special attachment for filling hand guns. Let's fill this hand gun, so you can compare the pumpability of this grease with what you are using. (Fill gun with filler attachment, hand to farmer.)

Farmer: (Pumps gun twice.) It's easy to pump all right.

Derby Salesman: This grease is made to pump well on the coldest days, and still have good body when we have a warm spell. In fact, it does such a good job under both hot and cold conditions that lots of people use one grade the year around. That saves changing grade when the seasons change, and eliminates carrying grease over from one winter or summer to the next.

Farmer: (Pumps gun again—feels and smells the grease.)

Derby Salesman: This grease not only pumps well at low temperatures, it's also completely resistant to water. I've a couple of tubes of water here—let's put some of this grease in one and some of yours in the other and see what happens. (Put grease in tubes and shake up.) You see how your fibre grease separates and dissolves while this one stays just the same? This can be real important to you next spring when you may have to operate your truck and car over wet roads. You won't have to worry about the grease washing out of any bearings for that matter.

Farmer: I have a gun grease I use when it's wet, and a water pump grease that won't dissolve in water.

Derby Salesman: That's true, except that those greases won't stay in the bearing as well because they get soft after you use them for awhile, and will let the mud and water get into the bearing. This grease makes a grease seal that keeps the grit out, and it doesn't soften up in use. (Hand grease folder.) This shows the equipment we use to test how well the different greases stand up in a bearing. You can see how well this grease held its body as compared to either a fibre or regular calcium gun grease.

Farmer: Will this work in water pumps?

Derby Salesman: It sure will! In fact, a regular water pump grease will separate if the water temperature gets much above 180°. This grease is not affected by hot or cold water. Let me show you another good quality of this grease. Let's melt some of your grease and some of this grease in a spoon and see what happens to it. (Run spoon test.) See how heat destroys your grease, while this one returns to a good lubricant. This grease will take more heat than you will ever have to worry about and if it does melt, it will set up again when the temperature drops a few degrees.

Farmer: What kind of grease is this?

Derby Salesman: It's the new Derby multi-purpose lithium.

Farmer: Lithium! I've heard of that. It costs too much for me. Farmers have to watch their money these days.

Derby Salesman: That's exactly why it's the product you need. Derby multi-purpose lith doesn't cost you more. It does cost a few pennies a pound more to start with, but it actually saves you money. It will save you time during the busy season, and that's money to you. It won't wash out or melt and it forms a grease seal to keep grit and water out of the bearings. Your machines will last longer, and repair parts are more expensive than any grease. A breakdown during harvest can really cost you plenty. You can also eliminate all of these other greases you have on hand. You can't help but waste a lot of grease before you use the special greases up.

Derby multi-lube lith will lubricate everything with one gun, and do it better, too. We can supply it in all size containers, including flaring pails and half bushels. These make dandy feed and water pails when empty.

Farmer: I might try some—guess the price is right!

Derby Salesman: (Gets out price book and order pad.) Yes sir, this is a good time to buy. We have a combination special sale on now—six 35-pound pails and the Jet-Zer-Ator.

Farmer: When you deliver the grease, bring out a

H. A. Mayor, Jr. *is executive vice president of Southwest Grease and Oil Company, Inc. After completing military service in World War II, Mayor joined Southwest as plant coordinator. He was elected to his present office in 1952. He is a graduate of the Oklahoma Military academy. Mayor is chairman of the Packaging Institute and a member of SAE and the API lubrication committee. He was elected to the NLGI Board of Directors in 1953. In addition he serves on the API-NLGI Joint Container committee, the NLGI Program and Publicity committees and is the NLGI liaison representative to the American Standards Association.*

O. Elliott *is president and general manager of National Sales, Inc. Elliott was first employed as acting advertising manager for Cessna Aircraft company and following his graduation from Wichita university was head of employee relations for Cessna for three years. Elliott was sales representative for a Wichita commercial printing company after leaving Cessna. He joined National Sales in 1948 as vice president and general manager, one year after the company was formed, and was elected president in 1952.*

About the Authors

J. R. Hodges *is sales representative for Southwest Grease & Oil Company, Inc. He received a B.S. from Kansas State College and then joined Sinclair Refining company as territory manager. Hodges joined Southwest in August, 1955, and after extended plant and laboratory duty, assumed responsibility for the sales of Sowesco products in an eight state midwestern area. He is a member of SAE and the Wichita Oil Men's club.*

half drum of 10W-30. My fuel tank is low, too, so you might as well fill it up. Let's go into the house where it's not so cold. Maybe the wife has some hot coffee.

Curtain Closes

Knowledge had become selling power—an order, the lifeblood of our industry, has been booked and enthusiastic, exciting plant action would soon follow.

Curtain Opens Again on Scene IV

In retrospect, let's title Scene I, "Empathy." Empathy is a pet, successful technique of my father, the president of our company, who many of us sincerely believe to be the world's greatest grease salesman. He, in this instance, simplifies Webster in his definition of empathy as "Putting yourself in the place of the person you have come to sell." That person, just like you, can sell only that with which he is familiar. In your sales training, oversimplify the facts and you'll oversell your quotas. Think it over—at any and all sales levels, with *empathy*, you can't go wrong!

Scene II can be effectively summarized. This is an abbreviated form of that helpful, guiding sales philosophy that was depicted by our multi-purpose grease demonstration, *facts* become *potent* only when *palatable*.

Scene III was dedicated to "bridging the gap," the strengthening of the chain of our products from our plants to the consumer. If we pack our products in colorful, practical containers and simplify the methods through which our products are used, we'll create buyer appeal that will effectively germinate sales.

In conclusion "magic?" is the title of our last scene. Yes, it's a take-off from our movie seen this morning, but yet even more meaningful! True, it's easily realized that there's no room for magic in our sales work. True sales magic, like sales luck, is only preparation meeting opportunity. Our salesman today was no magician. He had a good product with which he was familiar. It was properly packaged. It could be easily and efficiently dispensed with the equipment which he cleverly combined into his sales approach.

Also, there was nothing magical about the resulting order. Significantly though, the resulting order was for the magic film! As shown today, grease is the magic film, not because of its mysterious powers to reduce friction, nor because of its mysterious chemical or physical make-up. Lubricating grease *is* the magic film, for how else could one account for the orders covering other petroleum products that so often ride the shirt tails of a grease purchase. It's a regularly recurring phenomenon that proves without a doubt that grease, the product of our industry, is truly "the magic film." ■

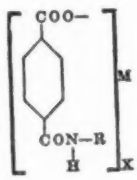
Patents and Developments

Greases Gelled with Inorganic Colloids

Patent No. 2,820,006 issued to J. B. Matthews and S. Dawtrey, assigned to Shell development company. Thickened lubricating greases are prepared by mixing a hydrogel of an inorganic colloid, e.g., Wyoming bentonite or hectorite, with a lubricating oil, a hydrophobic surface-active agent (e.g., an oil soluble condensation product of epichlorohydrin and ammonia converted into a partial amide by reacting with stearic acid), and enough of a mutual solvent, such as an alcohol or ketone, to produce a homogeneous liquid phase when the mixture is heated, under pressure, if necessary. Then, the water is distilled off, with the solvent (if desired), while maintaining the liquid phase homogeneous. The latter is important as otherwise the product is not mechanically stable. Such gels are claimed to have an unexpected and substantial increase in surface area as well as improved corrosion characteristics. Amounts of the ingredients used based on the weight of the colloid, are: surface-active agent 25-100 per cent, mutual solvent in weight ratio with respect to water present 5.6:94.4 to 20:100 (water to solvent ratio).

High Temperature Phthalamate Grease Compositions

Patent 2,820,012 issued to B. H. Hotten and assigned to California research corporation. Greases capable of lubricating effectively at temperatures considerably in excess of 400°F. and, in certain instances, in the range of 500°F. and higher, are claimed to be produced by thickening the lubricating oil with metal salts of certain terephthalamic acids having the following formula:



wherein R is an organo radical (straight chain, or cyclic, saturate or unsaturated hydrocarbon radical), M is a metal of groups I, II, III and IV of the periodic table, and X is a number having a value equal to the valence of M. As a straight chain or branched chain radical, R can contain 1-22 carbon atoms. As a cyclic radical, R can contain 6-28 carbon atoms. When R is a straight chain or branched chain radical containing less than 4 carbon atoms, it is preferred to use a gel-transfer method in the preparation of the grease structure. Examples of R include methyl, ethyl, 2-ethyl hexyl, ethlphenyl, etc, Lithium, sodium and barium are the preferred metals. Isophthalamic acid salts also may be employed. It is preferred to use 7-30 per cent of the salt in the lubricating oil.

Corrosion Inhibited Greases Containing Lithium Soaps of Hydroxy Fatty Acids and Mahogany Sulfonates

Patent 2,820,009 issued to J. D. Smith and H. L. Hendricks, assigned to Shell development company. Lubricating greases containing lithium soaps of hydroxy fatty acids and calcium mahogany sulfonates are made more corrosion resistant and more adherent to iron surfaces by effectively and permanently dispensing therein 0.5-2.5

per cent of water soluble nitrites and/or chromates, the calcium sulfonate serving to prevent separation thereof and used in an amount of 1 per cent to 2.5 per cent by weight of the total grease. The lithium soaps are the soaps of hydroxy fatty acids having 12-24 carbon atoms per molecule, e.g., hydrogenated castor oil, 9, 10-dihydroxy stearic acid, 4-hydroxy palmitic acid, etc. The water soluble nitrates or chromates include sodium nitrite, ammonium nitrite, ammonium chromate, dicyclohexylamine nitrite, etc., and they may be added in the form of aqueous solutions. Examples also include phenyl-alpha-nathphylamine.

Clay Bodied Grease Compositions

Patent 2,819,210 issued to W. L. Haden, Jr., and C. O. Martin, assigned to Minerals & Chemicals corporation of America. Bodying agents possessing no dropping point, excellent mechanical stability and corrosion protection are prepared by using a naturally-occurring clay having a surface area, after drying, of preferably 100 square meters per gram or more, which is adjusted to a moisture content preferably of 5-30 per cent. To this clay are added two synergistic hydrophobic surface-active agents, namely, an alkylammonium salt of a mono-alkyl alkylamido phosphate, and a tertiary amine having a single alkyl group and two polyoxyethylene groups as substituents on the nitrogen atom. An example of the former surface-active agent is "Victamine C" produced by Victor chemical works, while an example of the latter is "Ethomeen 18/12" produced by Armour chemical division. About 1-8 per cent by weight of surface-active agents, based on the total weight of grease constituents is sufficient, the ratio of the former to the latter surface-active agent being about 4 to 1.

Almunia Aerogels

U. S. Patent 2,816,079 issued to J. F. White, assigned to Monsanto chemical company. An aluminum aerogel which might be suitable as a grease thickener is prepared by first contacting an aqueous solution of aluminum chloride with an amount of ethylene oxide sufficient to form a colloidally dispersed alumina and ethylene chlorhydrin which gels on standing. After the alumina hydrogel is formed, it is washed with a water-miscible organic liquid to remove substantially all of the ethylene chlorhydrin. Then the washed gel is heated under pressure in a pressure bomb until the temperature of the liquid of the gel exceeds the critical temperature of such liquid and the vapors are released at a rate insufficient to injure the original gel structure.

Other Grease Patents

U. S. Pat. 2,818,044 (International Harvester Co.)—Greasing machine for bearings or the like.

News Items

Effect of lubricant base stock on rolling-contact fatigue life: tests on a methyl silicone, a paraffinic mineral oil, a glycol, a sebacate, and an adipate, on life of M-1 tool-steel balls at 100°F. revealed that lubricants whose viscosities were increased the most by pressure produced the longest fatigue lives. (Carter, NACA Tech. Note 4161).

Kiln car bearing lubricants: types; properties; performance of high temperature greases, graphite, moly disulfide, etc. Best for 300-1200°F. general use is a properly compounded graphite grease; use of an inorganic gelling agent helps; positive lubrication can be obtained with new non-melting, non-carbonizing grease-containing micronized flake graphite dispersed in a synthetic oil and inorganic gelling agent. (Kiefer, Amer. Ceramic Soc. Bull. 2/58, p. 85).

NLGI Associate, Technical Members

CONTAINER AND CLOSURE MANUFACTURERS

American Can Company
4810 Belleview, Kansas City 12, Mo.
Representative—H. T. Rich

American Flange & Manufacturing Company, Inc.
30 Rockefeller Plaza, New York 20, N. Y.
Representative—Richard L. Parish, Jr.

Bennett Industries
Peotone, Illinois
Representative—S. A. Bennett

Central Can Company
2415 West 19th St., Chicago 8, Illinois
Representative—Henry Frazin

Cleveland Container Company
4925 So. Halsted St., Chicago 9, Ill.
Representative—R. D. Sayles

Continental Can Company, Inc.
100 East 42nd St., New York 17, N. Y.
Representative—W. J. Flint

Geuder, Paeschke & Frey Company
324 North Fifteenth St., Milwaukee 1, Wis.
Representative—Neil Savee

Inland Steel Container Company
6532 South Menard Ave., Chicago 38, Ill.
Representative—J. Daniel Ray

Jones & Laughlin Steel Corporation
Container Division
405 Lexington Ave., New York 17, N. Y.
Representative—C. K. Hubbard

National Steel Container Corp.
6700 South LeClaire Ave., Chicago 38, Ill.
Representative—Henry Rudy

The Ohio Corrugating Company
917 Roanoke Ave. S. E., Warren, Ohio
Representative—Lawrence F. McKay

Republic Steel Corporation
Container Division
465 Walnut Street, Niles, Ohio
Representative—Theodore Humphrey

Rheem Manufacturing Company
400 Park Ave., New York 22, New York
Representative—F. J. Blume

Rieke Metal Products Corporation
Auburn, Indiana
Representative—Mahlon E. Rieke

Steel Package Division of National Lead Company
722 Chestnut Street, St. Louis 1, Missouri
Representative—Warren T. Trask

United States Steel Products
Division, United States Steel Corporation
30 Rockefeller Plaza, New York 20, N.Y.
Representative—Wm. I. Hanrahan

Vulcan Containers, Inc.
P. O. Box 161, Bellwood, Illinois
Representative—L. M. Ferguson

ENGINEERING SERVICES

The C. W. Nofsinger Company
307 East 63rd Street, Kansas City 13, Missouri
Representative—C. W. Nofsinger

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

Balcrank, Inc.
Disney near Marburg, Cincinnati 9, Ohio
Representative—Richard P. Field

The Farval Corporation
3249 East 80th St., Cleveland, Ohio
Representative—Lee Witzenburg

Gray Company, Inc.
60 Northeast 11th Ave., Minneapolis 13, Minn.
Representative—B. A. Beaver

Lincoln Engineering Company
5701 Natural Bridge Ave., St. Louis 20, Mo.
Representative—G. A. Hubbard

Stewart-Warner Corporation
Alemite Division
1826 Diversey Parkway, Chicago 14, Illinois
Representative—E. G. Wicklatz

Trabon Engineering Corp.
28815 Aurora Rd., Solon, Ohio
Representative—E. W. Baumgardner

MARKETING ORGANIZATIONS

Ampol Petroleum, Ltd.
Buchanan Street
Balmain, New South Wales, Australia
Representative—L. Ashley

California-Texas Oil Company
380 Madison Ave., New York 17, New York
Representative—Hal U. Fisher

Canadian Petrofina Limited
505 Dorchester Street West
Montreal, Quebec, Canada
Representative—M. E. Wight

Cooperative GLF Exchange, Inc.
Terrace Hill, Ithaca, N. Y.
Representative—W. S. Miller

Denco Petroleum Company
5115 Denison Avenue, Cleveland 2, Ohio
Representative—I. L. Carmichael

Derby Refining Co.
420 West Douglas, Wichita, Kansas
Representative—W. B. Neil

D-X Sunray Oil Company
Mid-Continent Bldg., P.O. Box 381, Tulsa, Okla.
Representative—J. W. Basore

Farmer's Union Central Exch., Inc.
P. O. Box G, St. Paul 1, Minnesota
Representative—H. F. Wagner

Illinois Farm Supply Company
100 East Ohio Street, Chicago, Illinois
Representative—S. F. Graham

Ohio Farm Bureau Cooperative Association, Inc.
245 North High Street, Columbus 16, Ohio
Representative—Walter N. Callahan

Valvoline Oil Company
Division of Ashland Oil & Refining Co. Box G
Freedom, Pennsylvania
Representative—D. A. Smith

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Barrett Manufacturing Company
P. O. Box 8096, Houston 4, Texas
Representative—George J. Barrett, Jr.

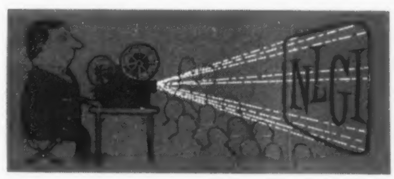
Chemicolloid Laboratories, Inc.
55 Herricks Road, Garden City Park, N. Y.
Representative—David F. O'keefe

The Girdler Company
A Div. of National Cylinder Gas Co. Box 987
Louisville 1, Kentucky
Representative—J. E. Slaughter, Jr.

Manton-Gaulin Mfg. Co., Inc.
44 Garden Street
Everett 49, Massachusetts
Representative—G. W. Eldridge

Morehouse-Cowles, Inc.
1156 San Fernando Rd., Los Angeles, Calif.
Representative—George E. Missbach

nlgi



4638 J. C. Nichols Parkway

NLGI Associate, Technical Members

Stratford Engineering Corporation
612 W. 47th Street, Kansas City 12, Missouri
Representative—D. H. Putney

Struthers Wells Corp.
1003 Pennsylvania Ave. West, Warren, Pa.
Representative—K. G. Timm

Sumner Sollitt Co.
307 N. Michigan Ave., Chicago 1, Ill.
Representative—A. J. Barth

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Acme-Hardesty Company
60 East 42nd St., New York 17, N. Y.
Representative—W. C. Hardesty

American Cyanamid Company
30 Rockefeller Plaza, New York 20, N. Y.
Representative—B. H. Loper

American Potash & Chemical Corp.
99 Park Avenue, New York 16, N. Y.
Representative—W. F. O'Brien

Archer-Daniels-Midland Company
Chemical Products Division
P. O. Box 839, Minneapolis 2, Minn.
Representative—J. H. Kane

The Baker Castor Oil Company
120 Broadway, New York 5, New York
Representative—J. W. Hayes

Baroid Division, National Lead Co.
2404 Danville, Houston, Texas
Representative—Mr. C. M. Finlayson

Godfrey L. Cabot, Inc.
77 Franklin Street
Boston 10, Mass.
Representative—H. P. Donohue, Jr.

Climax Molybdenum Company
500 Fifth Ave., New York 36, New York
Representative—Elwin E. Smith

Darling & Company
4201 South Ashland Ave., Chicago 9, Illinois
Representative—G. W. Trainor

E. I. du Pont de Nemours & Co.
Wilmington, Delaware
Representative—R. O. Bender

The Elco Lubricant Corporation
Jennings Road & Denison Avenue
Cleveland 9, Ohio
Representative—R. K. Smith

Emery Industries, Inc.
4300 Carew Tower, Cincinnati 2, Ohio
Representative—G. W. Boyd

Enjay Company, Inc.
15 West 51st St., New York 19, New York
Representative—G. M. Hebert

Foote Mineral Company
18 W. Chelten Ave., Philadelphia 44, Penn.
Representative—W. F. Luckenbach

A. Gross and Company
295 Madison Avenue, New York 17, N. Y.
Representative—Eugene W. Adams

The C. P. Hall Company of Illinois
5145 West 67th St., Chicago 38, Illinois
Representative—J. E. Stonis

Harchem Division
Wallace & Tiernan, Inc.
25 Main St., Belleville, N. J.
Representative—W. G. McLeod

The Humko Co. Chemical Dept.
P. O. Box 4607, 1702 N. Thomas St.
Memphis, Tennessee
Representative—W. J. O'Connell

Lithium Corporation of America,Inc.
Rand Tower, Minneapolis 2, Minnesota
Representative—Malcolm M. Moore

The Lubrizol Corporation
Box 3057—Euclid Station, Cleveland 17, Ohio
Representative—J. L. Palmer

Mallinckrodt Chemical Works
2nd & Mallinckrodt Sts., St. Louis 7, Missouri
Representative—D. B. Batchelor

The McGean Chemical Corp.
Midland Building, 101 Prospect Ave., N. W.
Cleveland 15, Ohio
Representative—W. A. Ritchie

Metasap Chemical Corporation
Harrison, New Jersey
Representative—O. F. Lohrke

Monsanto Chemical Company
800 North Twelfth Blvd., St. Louis 1, Mo.
Representative—J. W. Newcombe

Newridge Chemical Company
7025 West 66th Place, Chicago 38, Illinois
Representative—T. E. Shine

M. W. Parsons—Plymouth, Inc.
59 Beekman St., New York City 38, New York
Representative—Herbert Bye

Synthetic Products Company
1636 Wayside Rd., Cleveland 12, Ohio
Representative—Garry B. Curtiss

Swift & Company
165th & Indianapolis Blvd., Hammond, Ind.
Representative—F. H. Beneker

Vegetable Oil Products Co., Inc.
Vopcolene Division
5568 East 61st Street, Los Angeles 22, Calif.
Representative—C. F. Williams

Witco Chemical Company
122 East 42nd St., New York 17, New York
Representative—E. F. Wagner

TECHNICAL AND RESEARCH ORGANIZATIONS

American Lithium Institute, Inc.
P. O. Box 549,
Princeton, New Jersey
Representative—Marshall Sittig

Battelle Memorial Institute
505 King Avenue, Columbus 1, Ohio
Representative—S. L. Cosgrove

Compagnie Francaise De Raffinage
11 Rue du Dr. Lancereaux, Paris VIII^{e}, France
Representative—Albert E. Miller

Inland Testing Laboratories
6401 Oakton St., Morton Grove, Ill.
Representative—Dr. Morton Fainman

Institut Francais du Petrole
CMrR—Courtel, 4 Place Bir Hackeim
Rueil—Malmaison (S. et Oise) France

Laboratoires de Recherches Purfina S.A.
98/100 Chaussee de Vilvorde,
Bruxelles (N.O.H.), Belgium
Representative—R. Gillerot

Petroleum Educational Institute
9020 Melrose Avenue, Los Angeles 46, Calif.
Representative—G. A. Zamboni

Phoenix Chemical Laboratory, Inc.
3953 W. Shakespeare Ave., Chicago 47, Ill.
Representative—Mrs. G. A. Krawetz

Products Development Laboratory
1 Market St., West Warwick, Rhode Island
Representative—Alberic T. DiMasi

Veresit—Fabrica de Productos Quimicos S.R.L.
Monasterio 271, Buenos Aires, Argentina
Representative—Dr. Alexander Erdely

People in the Industry

New Board and Officers Announced by HEF Inc.

HEF, Inc., announced its board of directors comprised of three members each from the two parent companies, Hooker Electro-chemical company, Niagara Falls, New York and Foote Mineral company, Philadelphia, Pa.

Hooker's representatives on the board of the recently incorporated, jointly held firm are: R. Wolcott Hooker, F. Leonard Bryant and Dr. Marion B. Geiger. Foote's representatives are Felix B. Shay, John S. Gates and W. Frederick Luckenbach. Luckenbach was also elected a vice president. He is Foote's NLGI Company representative. Hooker and Foote each have a 50 per cent stock interest in the new corporation.

New Appointment

Blaw-Knox company, Pittsburgh, Pa., announces the appointment of John P. Wilson as eastern manager of petroleum sales for the chemical plants division. Mr. Wilson's headquarters will be in the company's New York City office, and he will be responsible for petroleum engineering sales along the eastern seaboard.

Mr. Wilson comes to Blaw-Knox after twelve years association with the Lummus company where he held responsible positions in sales, and process and project engineering. His experience also includes four years of chemical production, plant start-up procedure and equipment testing with the U. S. Rubber company.

Mr. Wilson was graduated from Yale university in 1942 with a B. S. degree in chemical engineering. He is a member of the American Petroleum Institute, the Yale club of New York City, Yale Engineering association, Phi Gamma Delta fraternity and Nomads (National Oil Equipment Manufacturers and Delegates Society).

William Luthi Joins Elco Lubricant Corporation

William (Bill) Luthi has joined the Elco Lubricant corporation as technical sales representative. Mr. Luthi's background includes product development and product application for the Standard Oil company (Ohio) and experience as a field service representative for the diesel division of General Motors. He is a member of the Society of Automotive Engineers.

U.S.I. Names La Marche Director of Production

Paul J. La Marche has been made director of production for U. S. Industrial Chemicals company, division of National Distillers and Chemical corporation; it has been announced by Robert H. Cornwell, vice president. He will be located at the company's New York office.

Mr. La Marche graduated from Case Institute of Technology in 1940 with a B. S. degree in metallurgical engineering. After completing college he was employed by Allegheny Ludlum Steel corporation, electrochemicals department of E. I. duPont de Nemours and Co. Inc., and the Lebanon Steel foundry in various supervisory and technical sales activities. Mr. LaMarche was works manager for the Premier Mill corporation in Geneva, New York prior to joining National Distillers in 1949. Shortly after joining the company he became manager of sodium sales. Since 1951 he has been manager of the company's Ashtabula, Ohio plants and was holding that position at the time of his new appointment.

Mr. La Marche is a member of the American Society for Metals and the Chemical Market Resarch association.

Vulcan Containers' Vern I. McCarthy, Jr. Named to BDSA Unit of National Defense Executive Reserve

Vern I. McCarthy, Jr., vice president of Vulcan Container Inc., Bellwood, Ill., has been named to the Business and Defense Services Administration's unit of the Na-

tional Defense Executive Reserve, according to H. B. McCoy, BDSA administrator.

McCarthy recently completed a six month tour of duty in Washington as deputy director of the Containers and Packaging division, BDSA, U. S. Department of Commerce. He is an authority on steel shipping containers and is also serving the government as a volunteer consultant to the Containers and Packaging division.

In his previous volunteer post as deputy director of the Containers and Packaging division, McCarthy represented the entire packaging and container industry. While serving on a "loan" basis to the government he was responsible for coordinating the overall relationship of the container industry with the Federal government. In that assignment he participated in the development of long-range mobilization plans and industrial defense preparedness programs for the U. S. container and packaging industry in the event of nuclear attack or other national emergency.

A navy veteran of World War II, he is the third generation of his family to be engaged in the steel shipping container and tin can field. McCarthy has conducted surveys of foreign container manufacturing programs and is intimately familiar with Canadian container production through his own company's subsidiary, Vulcan Containers Ltd. of Toronto.

C. W. Butler Succeeds J. E. Taylor at Gulf Research & Development

Announcement has been made of the appointment of Mr. C. W. Butler as director of the automotive engineering division, Gulf Research & Development company. He succeeds Mr. J. E. Taylor, who has been appointed director of automotive research and assigned to the company's newly opened office in Detroit.

In his new position, Mr. Butler, a veteran of 25 years of service with Gulf Research, will be responsible for directing the activities of approximately 130 personnel engaged in research on the company's automotive and aviation products.

A native of Washington, D. C., Mr. Butler received a B. S. degree in electrical engineering from the University of Maryland in 1927.

He first joined Gulf Research in 1933, working on a service station equipment evaluation project. In 1935, he was named section head of a newly organized automotive section of the engineering division.

Mr. Butler was appointed to his most recent position of assistant to the director, automotive engineering division, in 1953.

He has been a member of the Society of Automotive Engineers since 1937, and was chairman of the Pittsburgh section of the society, 1945-46.

Gulf Research & Development Takes Steps to Coordinate Research Program

Recognizing the impact that changes in automotive design exert on the direction of the Gulf automotive products research program, the Gulf Research & Development company is taking steps to adequately coordinate its research program with those of the automotive industry. Mr. J. E. Taylor, formerly director of the automotive engineering division, has been appointed director, automotive research, for Gulf Research and Development company.

'Gulf believes that Mr. Taylor can handle his new responsibilities more effectively if he resides in the Detroit area. His office will be in the Creson building in Birmingham, but he will also maintain an office at the Gulf research center for periodic consultation with the research staff, in order to guide the research programs for which he is responsible.

Mr. Taylor will represent Gulf on the API automotive research committee and the motor, aviation and diesel divisions of the Coordinating Research Council, and other technical committees.

Holding a B. S. degree in mechanical engineering from the University of Pittsburgh, Mr. Taylor joined Gulf Research in 1934 as an automotive engineer. In 1949, he was transferred to the parent company, Gulf Oil corporation, as chief product engineer, gasoline section, product development and product engineering, domestic marketing department.

He remained in that capacity until 1952, when he was transferred back to GR&DC and appointed director of the newly established automotive engineering division, comprised of the aviation, automotive fuels, automotive lubrication, and the automotive service sections.

Industry News

Important Lubricant Test Data Presented

Dramatic evidence that molybdenum disulfide lubricants reduce wear of metal parts subjected to critical operating conditions was presented to the Los Angeles chapter of the American Society of Lubricating Engineers on March 12 by Mr. Elwin E. Smith, manager of chemical sales for Climax Molybdenum company. Climax is a division of American Metals Climax, Inc.

Evaluating the performance of molybdenum disulfide additive according to standards of the National Advisory Committee for Aernautics, Mr. Smith backed up his remarks with data from tests conducted for the military on oscillatory anti-friction bearings. In these tests ten identical, new bearings were subjected to an oscillatory motion over a 90° angle at a rate of 260 reversals per minute. The result? Grease containing 3 per cent molybdenum disulfide additive extended lubrication some 1,000,000 revolutions.

Covering the technical aspects of molybdenum disulfide's performance in a wide range of other applications, he first explained how the additive functions and then related each function to specific test results. He traced molybdenum disulfide's unusual lubricating abilities to its unique combination of physical properties. It films out on surfaces, provides a strong and durable bond, maintains a low coefficient of friction, remains thermally stable, and resists chemical attack.

Some of the data used by Mr. Smith to illustrate the superior wear resistance of parts treated with molybdenum disulfide lubricants came from the following tests: U. S. Navy Falex wear test; Shell Four Ball wear test; Timkin wear test; Oscillating Friction Machine test for chassis lubricants; and the Kugelfischer grease test. In addition, extensive data from commerical (actual operation) trials was presented.

Newsletter Features Lubrication Tips for Cold Forming Operations

According to the current issue of Lubrication Newsletter, a substantial reduction in metal pickup on dies in metal forming operations is possible if Molykote lubricants are used to lubricate the dies. This results in the reduction of scuffing due to metal pickup and makes possible a considerable increase in die life. *Continued, next page*

New Aro Economy Line

A new economy line of overhead hose reels, designed to provide fast and efficient performance at low cost, is announced by the Aro Equipment corporation, Bryan, Ohio.

Any number of reels can be easily installed in multiple mountings for chassis, gear, motor oil, air, water and automatic transmission service. Also, additional reels can be added with ease at any time.

An automatic reel latch holds withdrawn hose in any position until operator is ready to return it. This eliminates need to pull or tug on hose while lubricating. The reels have strong spring-return action to retract hose smoothly after use. Hose damage is reduced by the use of these reels which keep service assemblies off the floor, out of the way, yet within easy reach.

Also discussed in the Newsletter (bulletin 304) are economical methods in which Molykote lubricants can be applied to fit the particular requirements of a variety of cold forming and stamping operations.

Copies of the Lubrication Newsletter are available from the Alpha-Molykote corporations, Stamford, Conn.

New Barrel Rack Literature Available

How modern materials handling techniques can be applied to steel drums for the first time by the use of newly developed portable steel barrel racks is described in literature available from Republic Steel corporation. A four-page brochure illustrated in color tells how the barrel racks permit the handling of stacked or empty barrels and drums with standard fork lift trucks.

Barrels can be stacked to any practical height with the new units which are designed for two- and four-way fork lift truck entry.

Bulletin 961 is available from the pressed steel division of Republic Steel corporation, 6100 Truscon avenue, Cleveland 27, Ohio.

Baroid Announces New York Office

Baroid division, National Lead company has announced the location of a New York office for Baroid Chemicals, Inc., at 111 Broadway in New York City. Edward Z. Walden, sales engineer for Baroid chemicals, will work in a dual capacity, serving also as export sales representative for Baroid division at that address.

A native New Yorker, Walden is a graduate of New York university, receiving his BS Degree in chemistry and has also done graduate work at New York university and the University of Pittsburgh. Walden spent four years with Mellon institute in Pittsburgh on a fundamental study of starch chemistry.

American Potash and Lindsay Chem. Co. Merge

Announcement has been made by Peter Colefax, president of American Potash & Chemical corporation, and Charles R. Lindsay, III, president of Lindsay Chemical company, that the boards of directors of the two companies have agreed to a merger of Lindsay Chemical into American Potash, subject to approval by the shareholders of each company at meetings to be held on April 29, 1958.

Emery Moves Philadelphia Sales Office

Emery Industries, Inc., has moved its Philadelphia sales office to 4343 East River drive, it was announced. The office was previously located at 401 N. Broad St.

The expanded facilities will en-

able Emery to offer increased service to greater Philadelphia accounts, and will serve as headquarters for J. P. Clancy, eastern district sales manager of Emery's organic chemical sales department, and J. P. Kramer, sales representative of the fatty acid sales department.

Emery products handled by the office include a complete line of fatty acids and hydrogenated glycerides, special monobasic and dibasic acids, diesters for synthetic lubricants, oleic esters, plasticizers, textile finishing oils and softeners, and emulsifiers.

Amalie Solves Problem

A quick answer to the problem of noisy, creaking front suspension ball joints in some 1955 and later Fords and Mercurys is offered by Amalie Black Velvet lubricant.

Amalie Black Velvet ball joint suspension grease is formulated from a heavy-duty, highly water-resistant chassis lubricant fortified with graphite and other load-carrying and corrosion-resistant additives. It has unusual tenacity, endurance and strength, to assure prolonged and effective lubrication of the heavily stressed and loaded bearing surfaces characteristic of all types of ball joint and torsion bar suspensions.

Inquiries concerning this new product should be directed to the Amalie division of L. Sonneborn Sons, Inc., at Franklin, Pa.

Rieke Metal Products Announce New Closure Development

Rieke Metal Products corporation of Auburn, Indiana has announced a new closure development, the self venting FlexSpout closure for liquid shipments, according to Glenn T. Rieke, president.

The FlexSpout incorporates an ingenious internal vent feature that obviates the necessity for other separate vents or closures on steel or fibre shipping containers. This new closure is a completely assembled unit that requires no positioning or registration when affixed to the container. It completely eliminates the liquid surge in pouring and allows more rapid drainage. Waste and spillage is eliminated as the closure will vent in any pouring position and a controlled flow, large or small, can be maintained.

Made of polyethylene, the new self venting FlexSpout insures leakproof and tamperproof delivery . . . it can be extended or recessed as desired for storage and stacking. Samples of the FlexSpout are available upon request.